US009189969B1

(12) **United States Patent**
Taylor

(10) **Patent No.: US 9,189,969 B1**
(45) **Date of Patent: Nov. 17, 2015**

(54) **SYSTEM AND METHOD FOR CONTROLLING AN ADVANCING READING SLOT OF A READING AID AT VARIABLE VELOCITIES**

(71) Applicant: **Fluent Reading Technology**, Key Biscayne, FL (US)

(72) Inventor: **Stanford E. Taylor**, Burlington, VT (US)

(73) Assignee: **Fluent Reading Technology**, Key Biscayne, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/307,037**

(22) Filed: **Jun. 17, 2014**

(51) **Int. Cl.**
G09B 17/00 (2006.01)
G09B 17/02 (2006.01)

(52) **U.S. Cl.**
CPC ***G09B 17/02*** (2013.01)

(58) **Field of Classification Search**
USPC 434/178, 179, 180, 181, 182, 183
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,502,406	A	3/1970	Macomber	
3,757,432	A	9/1973	Taylor	
3,878,327	A	4/1975	Uhler	
3,905,695	A	9/1975	Taylor	
3,938,139	A	2/1976	Day	
4,770,635	A	9/1988	Gabay	
6,056,551	A	5/2000	Marasco	
6,726,487	B1	4/2004	Dalstrom	
6,925,613	B2	8/2005	Gibson	
7,173,621	B2	2/2007	Reber et al.	
8,360,779	B1 *	1/2013	Brennan	434/181
2002/0167534	A1	11/2002	Burke	
2007/0202474	A1	8/2007	Miller	
2009/0042172	A1	2/2009	Morris	
2009/0144654	A1	6/2009	Brouwer et al.	

* cited by examiner

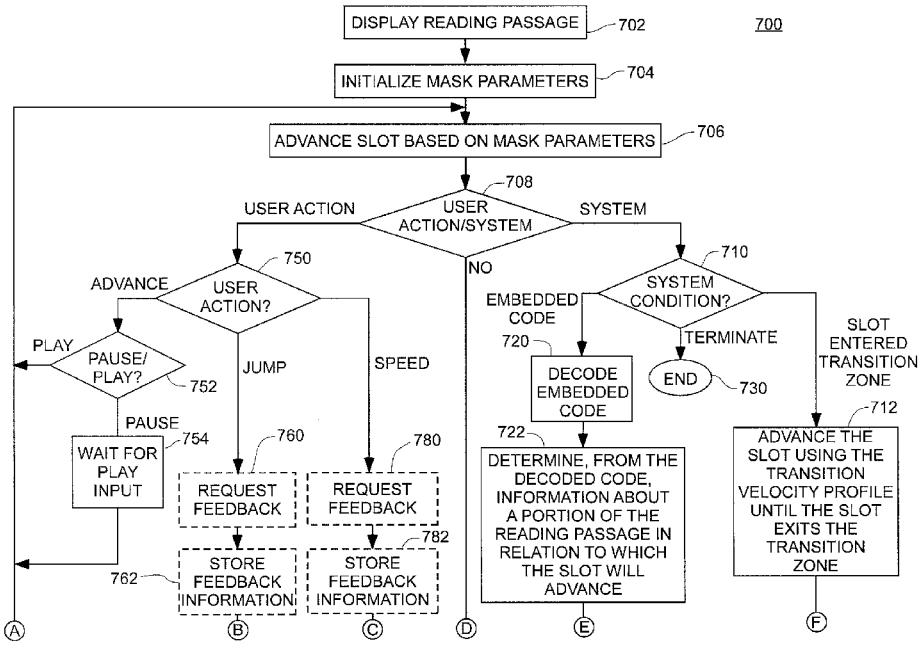
Primary Examiner — Kesha Frisby

(74) *Attorney, Agent, or Firm* — Hoffmann & Baron, LLP

(57) **ABSTRACT**

A system and computerized method is provided that controls a reading slot to provide aid to a user in reading a passage. The computerized method includes generating a mask having an opaque portion and a reading slot. The opaque portion covers a plurality of lines having characters that are visible through the slot. The plurality of lines includes at least a first line and a second line. The method includes advancing the slot at a midline velocity in relation to the first line of the passage, and increasing the velocity of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage.

32 Claims, 10 Drawing Sheets



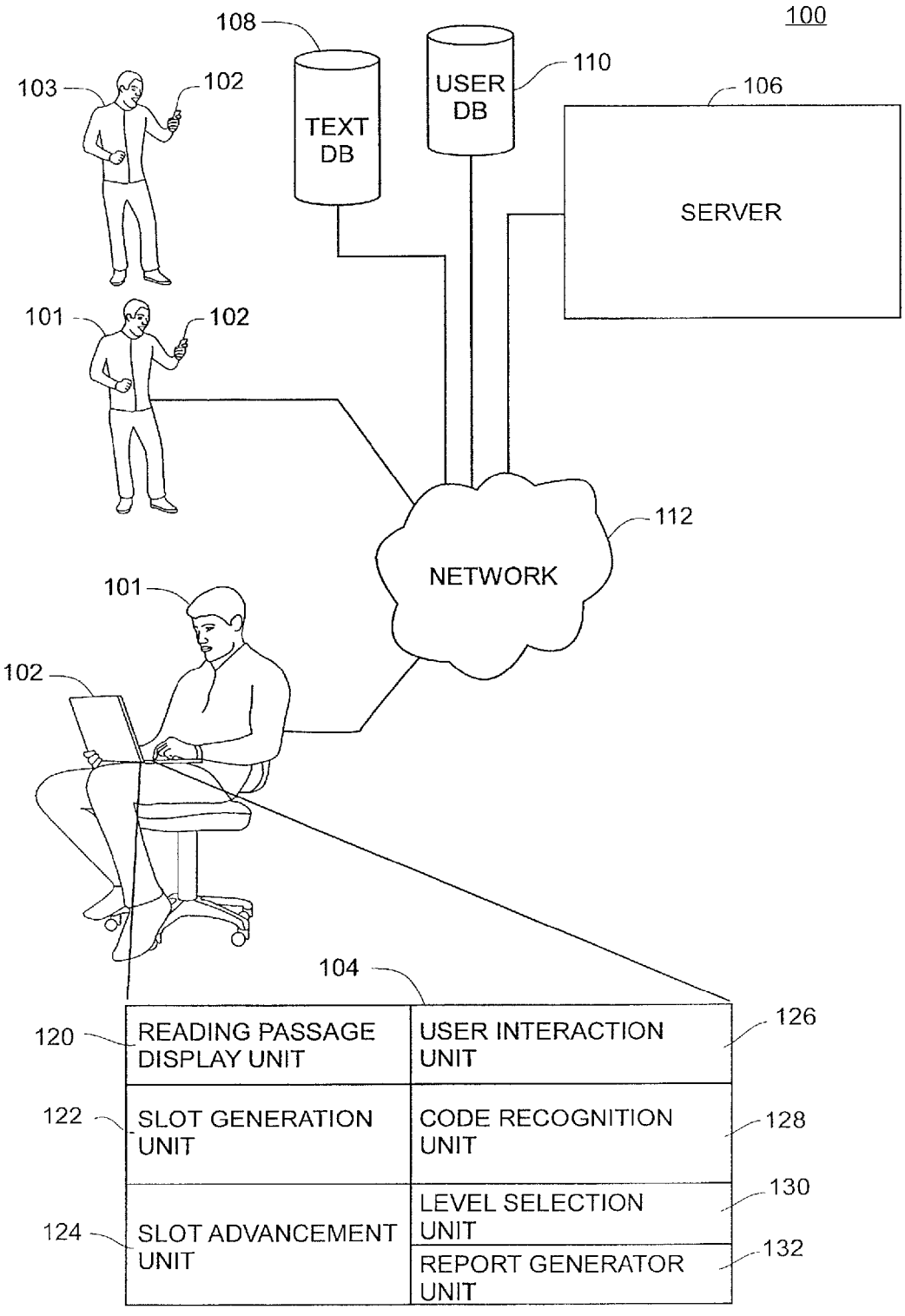

100
108
TEXT DB
USER DB
110
106
SERVER
103
102
101
102
112
NETWORK
101
102
104
120
READING PASSAGE DISPLAY UNIT
USER INTERACTION UNIT
126
122
SLOT GENERATION UNIT
CODE RECOGNITION UNIT
128
130
124
SLOT ADVANCEMENT UNIT
LEVEL SELECTION UNIT
REPORT GENERATOR UNIT
132

Fig. 1

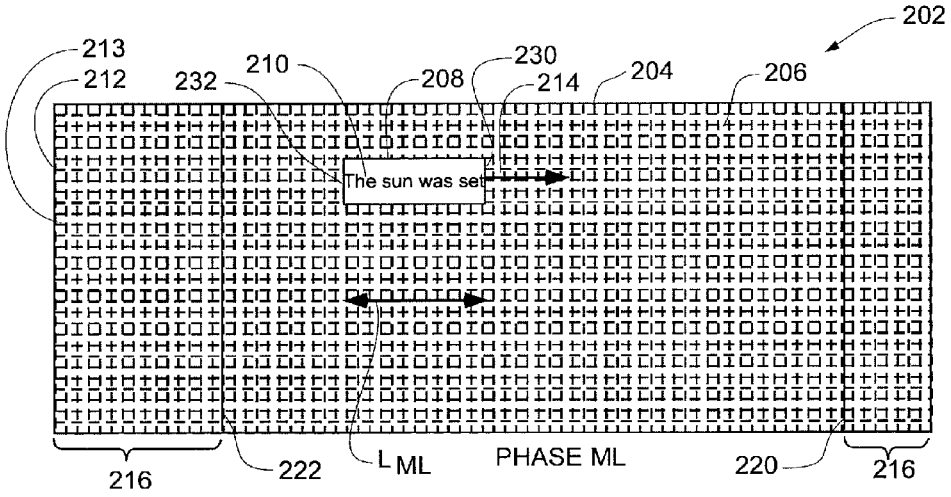

202
213
212
232
210
208
230
214
204
206
The sun was set
L ML
PHASE ML
216
222
220
216

Fig. 2A

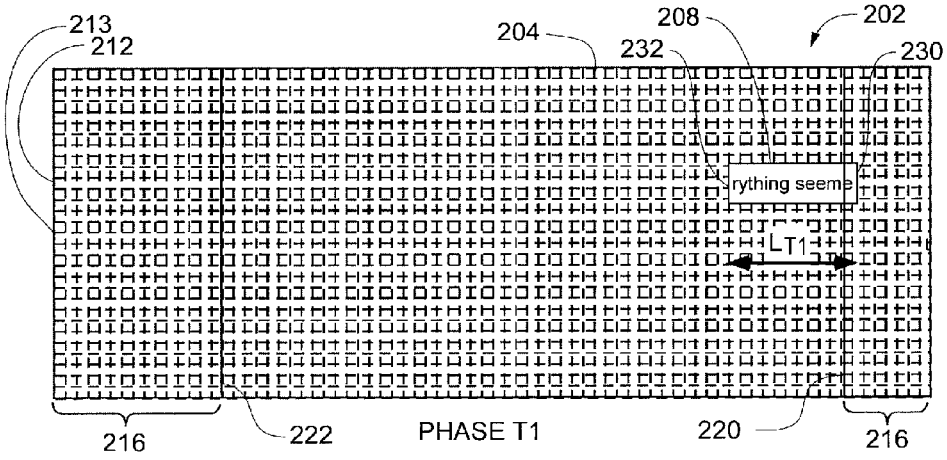

213
212
204
208
232
202
230
rything seeme
LT1
PHASE T1
216
222
220
216

Fig. 2B

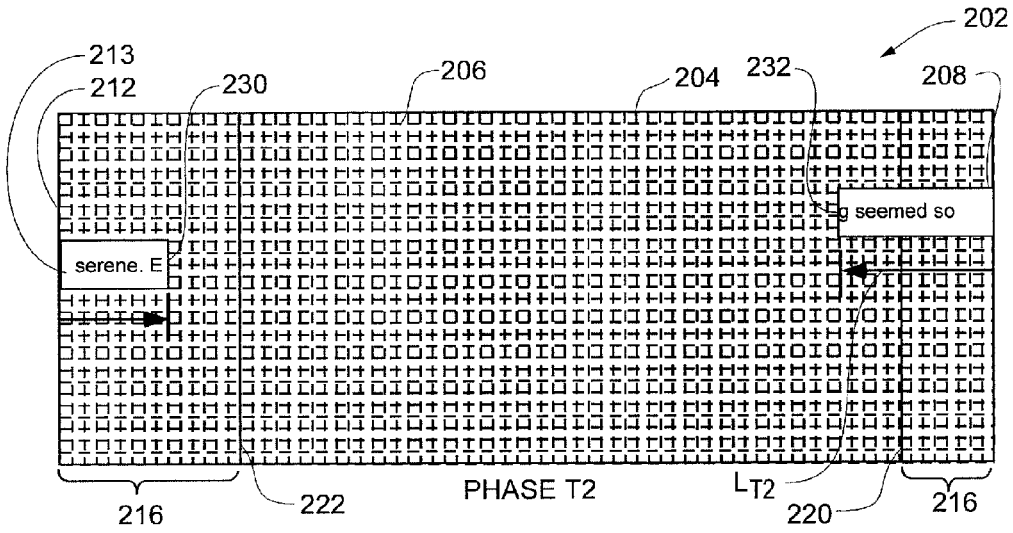

202
213
212
230
206
204
232
208
serene. E
g seemed so
PHASE T2
LT2
216
222
220
216

Fig. 2C

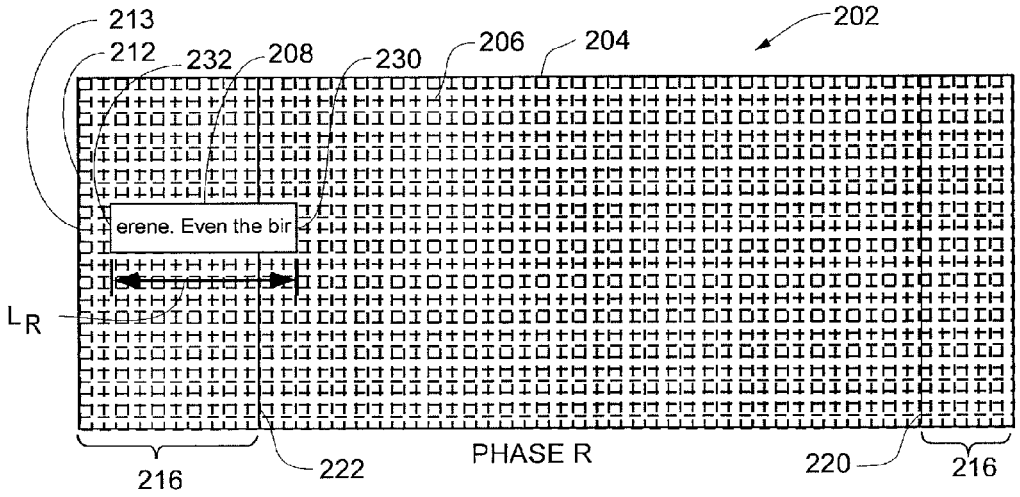

213
212
232
208
230
206
204
202
erene. Even the bir
LR
PHASE R
216
222
220
216

Fig. 2D

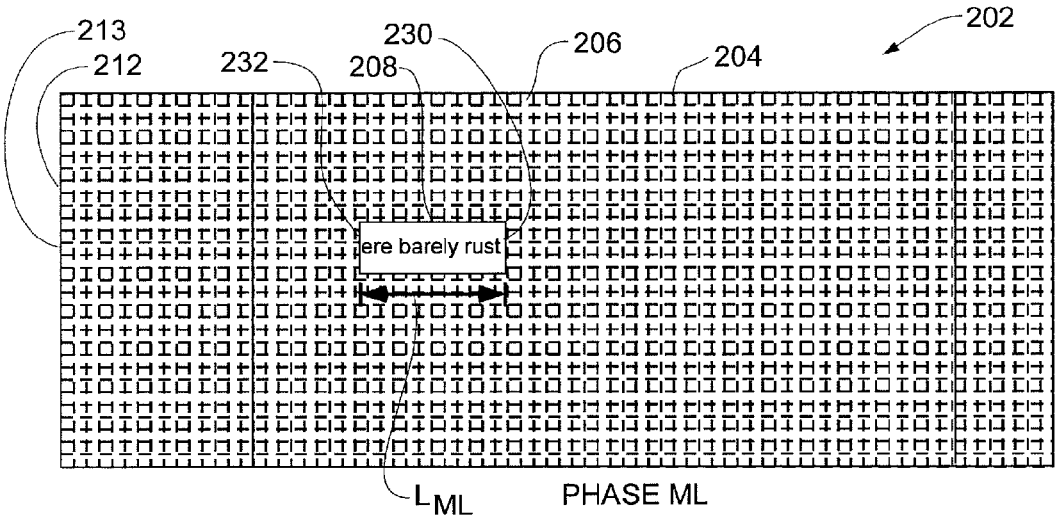

213
212
232
230
208
206
204
202
ere barely rust
L_{ML}
PHASE ML

Fig. 2E

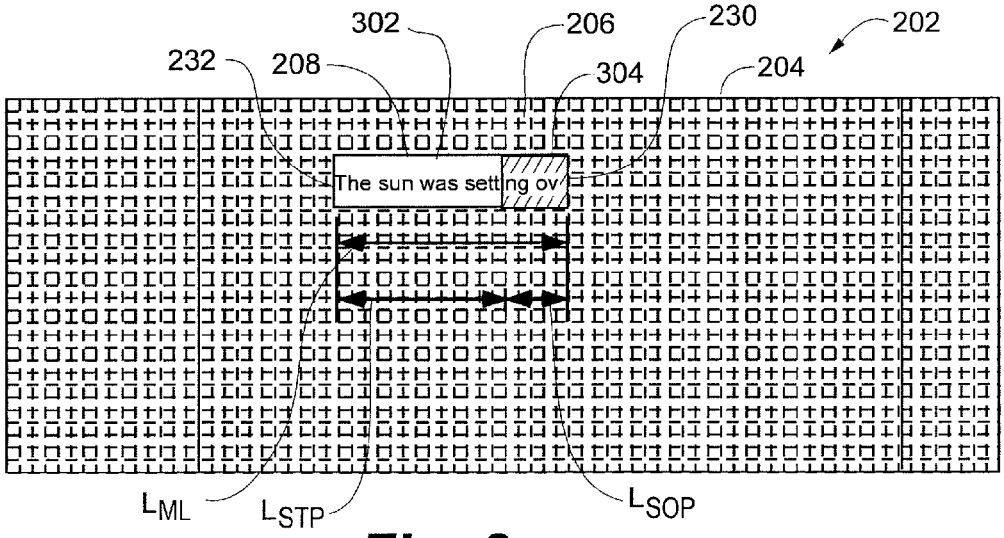

302
206
230
202
232
208
304
204
The sun was sett ng ov
L_{ML}
L_{STP}
L_{SOP}

Fig. 3

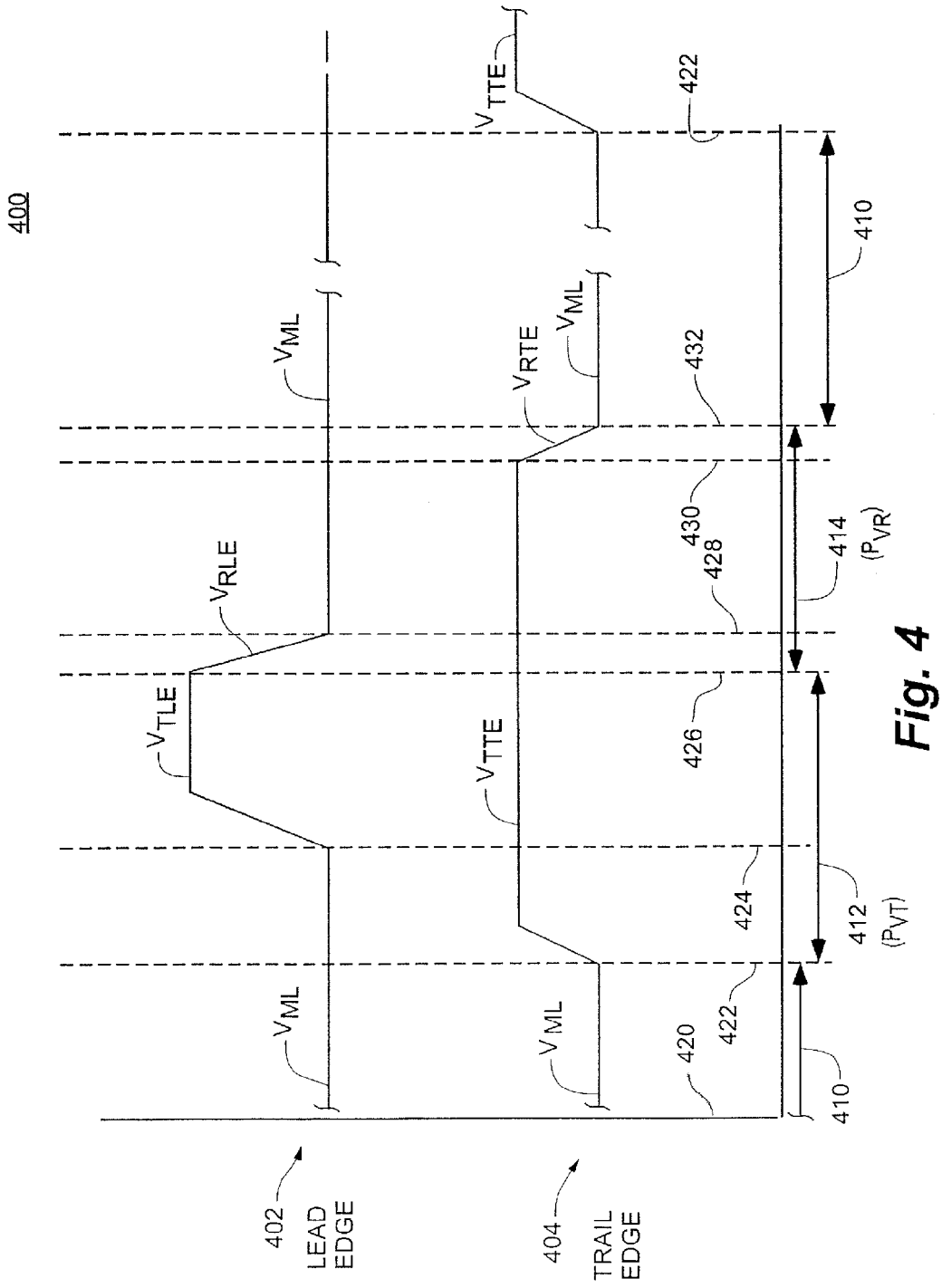

400
V_{ML}
V_{RLE}
V_{TLE}
V_{TTE}
V_{RTE}
V_{ML}
V_{TTE}
V_{ML}
V_{ML}
422
410
432
430
428
414
(P_{VR})
426
424
412
(P_{VT})
420
422
410
402
LEAD EDGE
404
TRAIL EDGE

Fig. 4

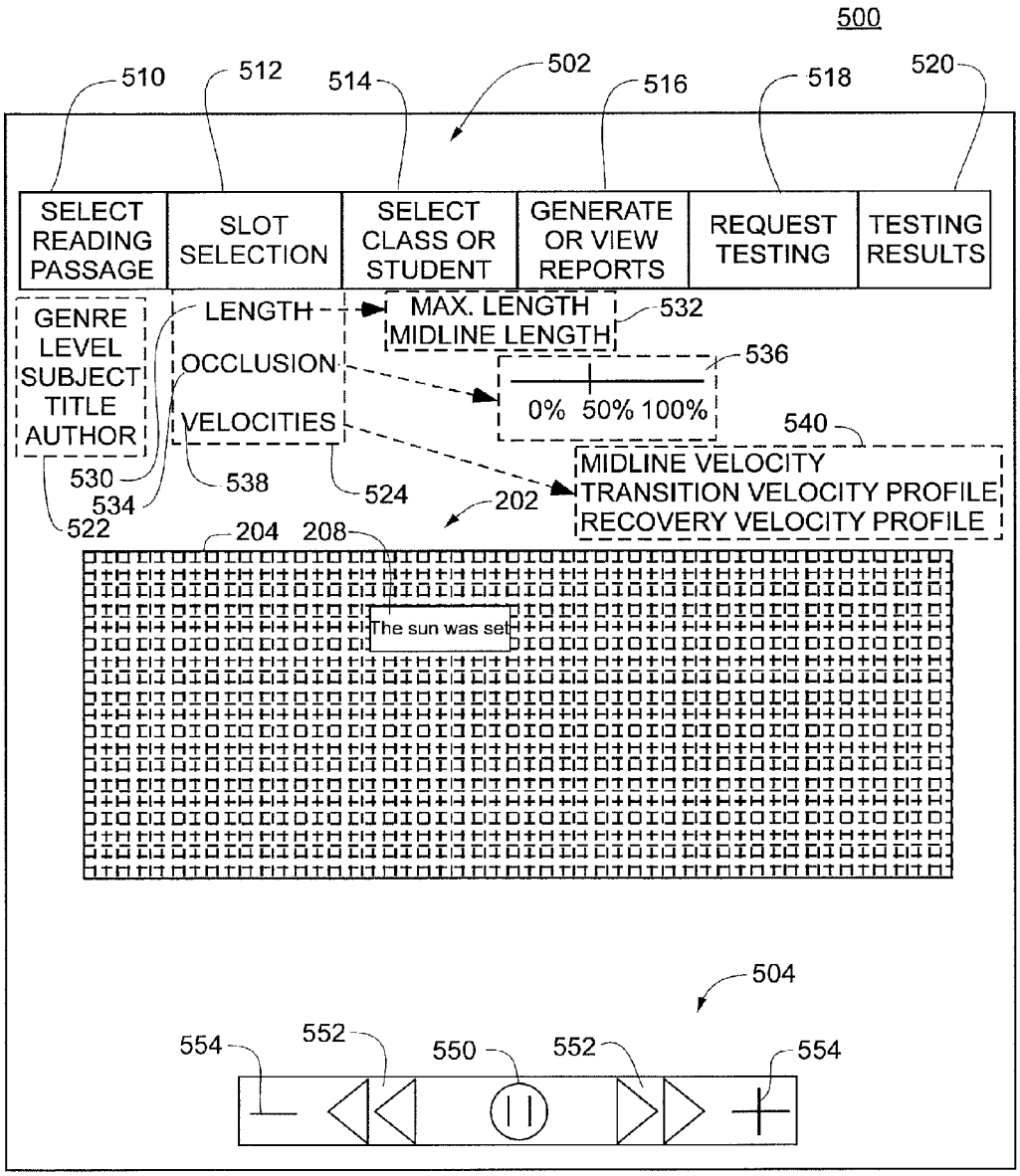

500
510
512
514
502
516
518
520
SELECT READING PASSAGE
SLOT SELECTION
SELECT CLASS OR STUDENT
GENERATE OR VIEW REPORTS
REQUEST TESTING
TESTING RESULTS
GENRE
LEVEL
SUBJECT
TITLE
AUTHOR
LENGTH
OCCLUSION
VELOCITIES
MAX. LENGTH
MIDLINE LENGTH
532
536
0% 50% 100%
540
MIDLINE VELOCITY
TRANSITION VELOCITY PROFILE
RECOVERY VELOCITY PROFILE
530
534
522
538
524
202
204
208
The sun was set
504
554
552
550
552
554

Fig. 5

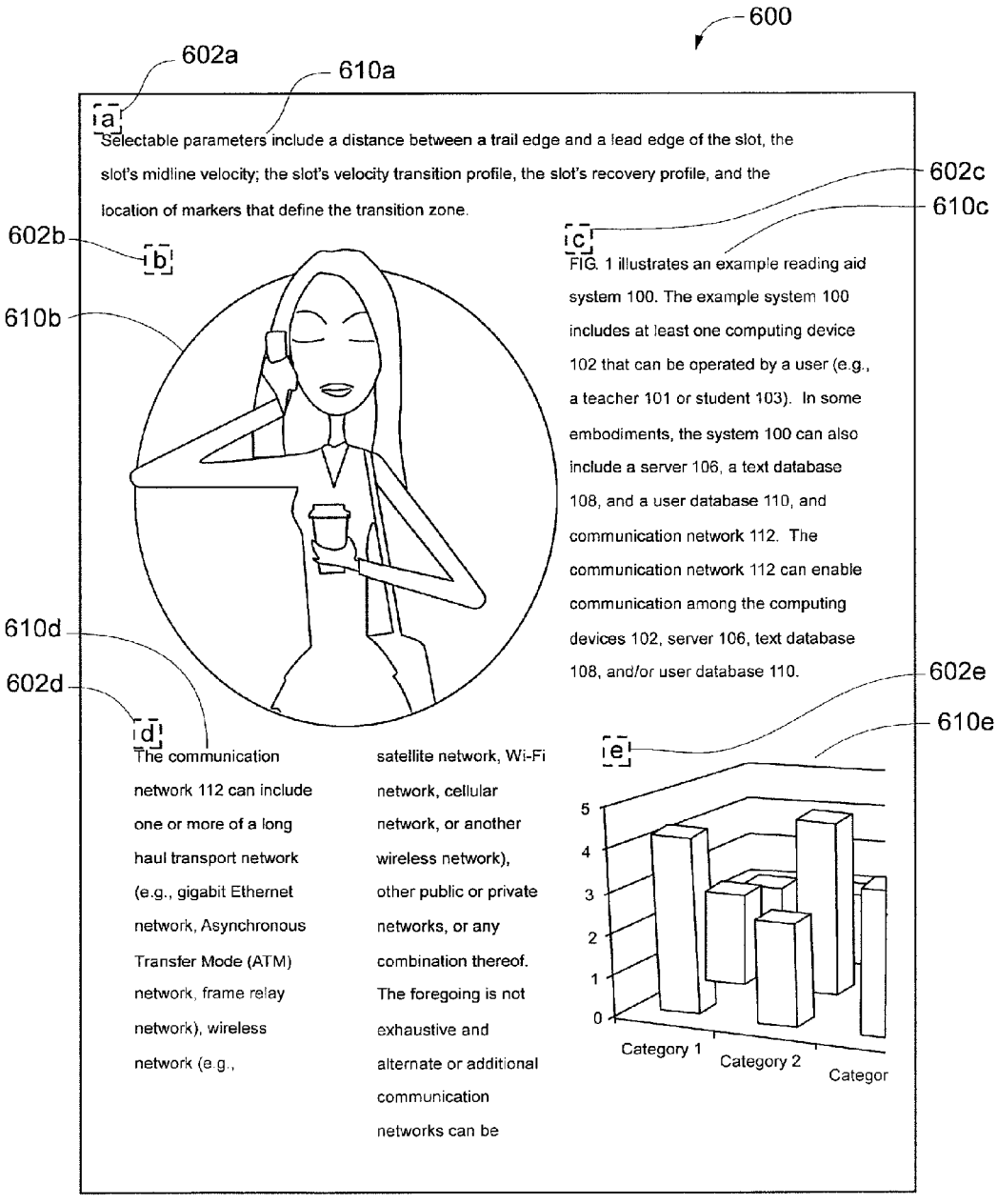

600
602a
610a
a
Selectable parameters include a distance between a trail edge and a lead edge of the slot, the slot's midline velocity; the slot's velocity transition profile, the slot's recovery profile, and the location of markers that define the transition zone.
602c
610c
c
FIG. 1 illustrates an example reading aid system 100. The example system 100 includes at least one computing device 102 that can be operated by a user (e.g., a teacher 101 or student 103). In some embodiments, the system 100 can also include a server 106, a text database 108, and a user database 110, and communication network 112. The communication network 112 can enable communication among the computing devices 102, server 106, text database 108, and/or user database 110.
602b
b
610b
610d
602d
d
The communication network 112 can include one or more of a long haul transport network (e.g., gigabit Ethernet network, Asynchronous Transfer Mode (ATM) network, frame relay network), wireless network (e.g., satellite network, Wi-Fi network, cellular network, or another wireless network), other public or private networks, or any combination thereof. The foregoing is not exhaustive and alternate or additional communication networks can be
602e
610e
e
5
4
3
2
1
0
Category 1
Category 2
Categor

Fig. 6

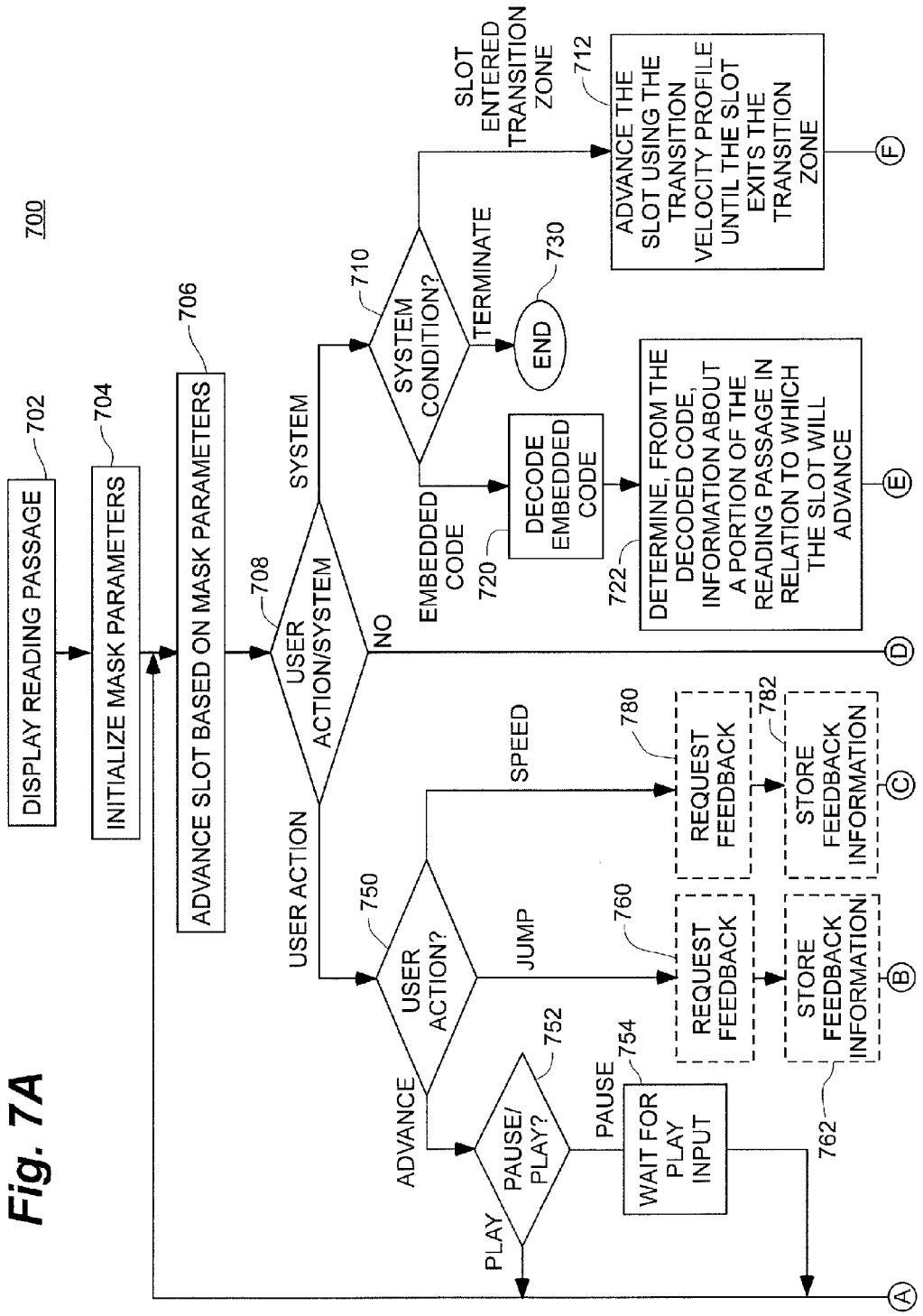

700
DISPLAY READING PASSAGE
702
INITIALIZE MASK PARAMETERS
704
ADVANCE SLOT BASED ON MASK PARAMETERS
706
USER ACTION/SYSTEM
708
SYSTEM
SYSTEM CONDITION?
710
TERMINATE
END
730
SLOT ENTERED TRANSITION ZONE
712
ADVANCE THE SLOT USING THE TRANSITION VELOCITY PROFILE UNTIL THE SLOT EXITS THE TRANSITION ZONE
EMBEDDED CODE
720
DECODE EMBEDDED CODE
722
DETERMINE, FROM THE DECODED CODE, INFORMATION ABOUT A PORTION OF THE READING PASSAGE IN RELATION TO WHICH THE SLOT WILL ADVANCE
NO
USER ACTION
USER ACTION?
750
SPEED
780
REQUEST FEEDBACK
STORE FEEDBACK INFORMATION
782
JUMP
760
REQUEST FEEDBACK
STORE FEEDBACK INFORMATION
ADVANCE
PAUSE/ PLAY?
752
PAUSE
754
WAIT FOR PLAY INPUT
PLAY
762
A
B
C
D
E
F

Fig. 7A

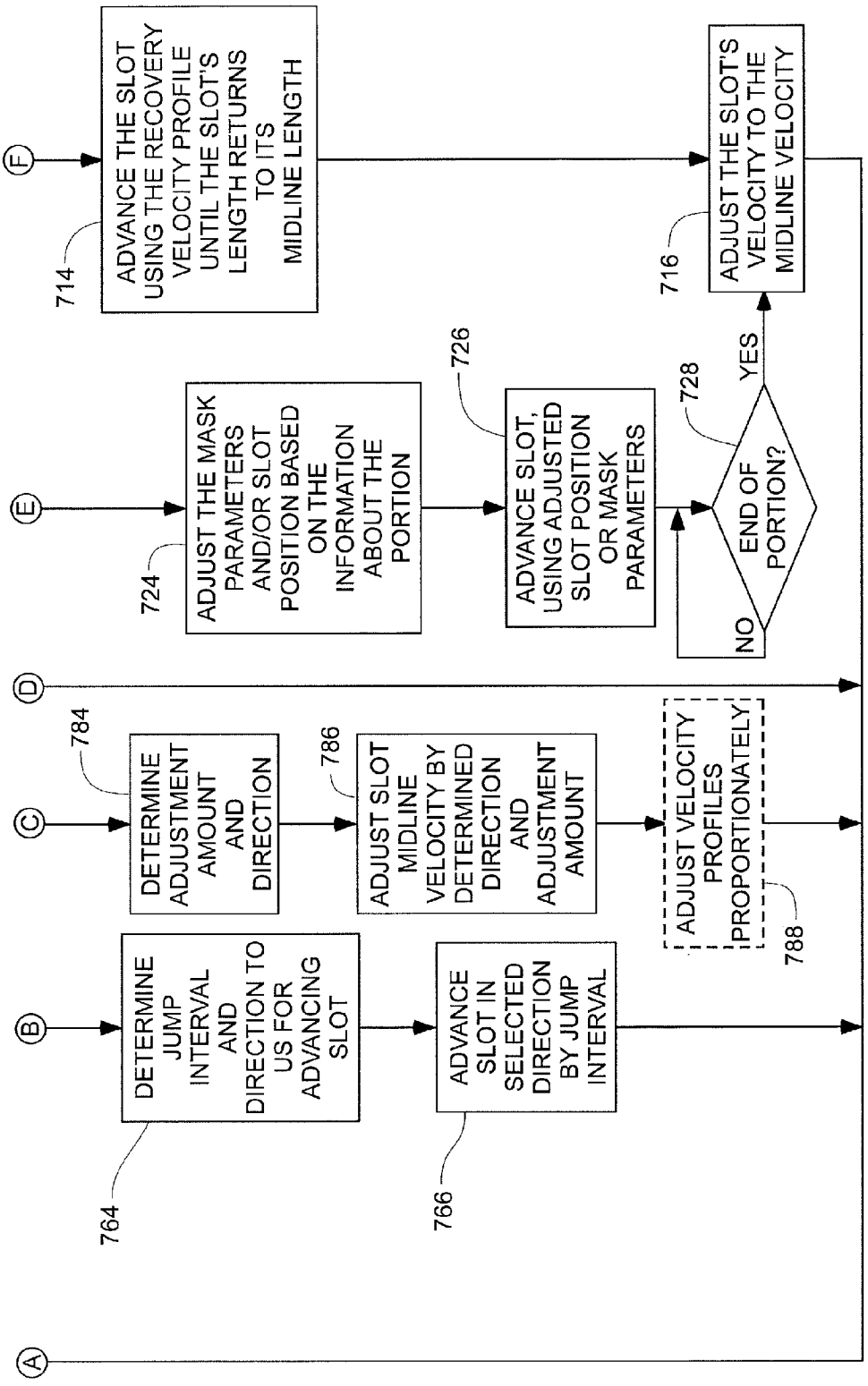

A
B
C
D
E
F
DETERMINE JUMP INTERVAL AND DIRECTION TO US FOR ADVANCING SLOT
764
ADVANCE SLOT IN SELECTED DIRECTION BY JUMP INTERVAL
766
DETERMINE ADJUSTMENT AMOUNT AND DIRECTION
784
ADJUST SLOT MIDLINE VELOCITY BY DETERMINED DIRECTION AND ADJUSTMENT AMOUNT
786
ADJUST VELOCITY PROFILES PROPORTIONATELY
788
ADJUST THE MASK PARAMETERS AND/OR SLOT POSITION BASED ON THE INFORMATION ABOUT THE PORTION
724
ADVANCE SLOT, USING ADJUSTED SLOT POSITION OR MASK PARAMETERS
726
END OF PORTION?
728
NO
YES
ADVANCE THE SLOT USING THE RECOVERY VELOCITY PROFILE UNTIL THE SLOT'S LENGTH RETURNS TO ITS MIDLINE LENGTH
714
ADJUST THE SLOT'S VELOCITY TO THE MIDLINE VELOCITY
716

Fig. 7B

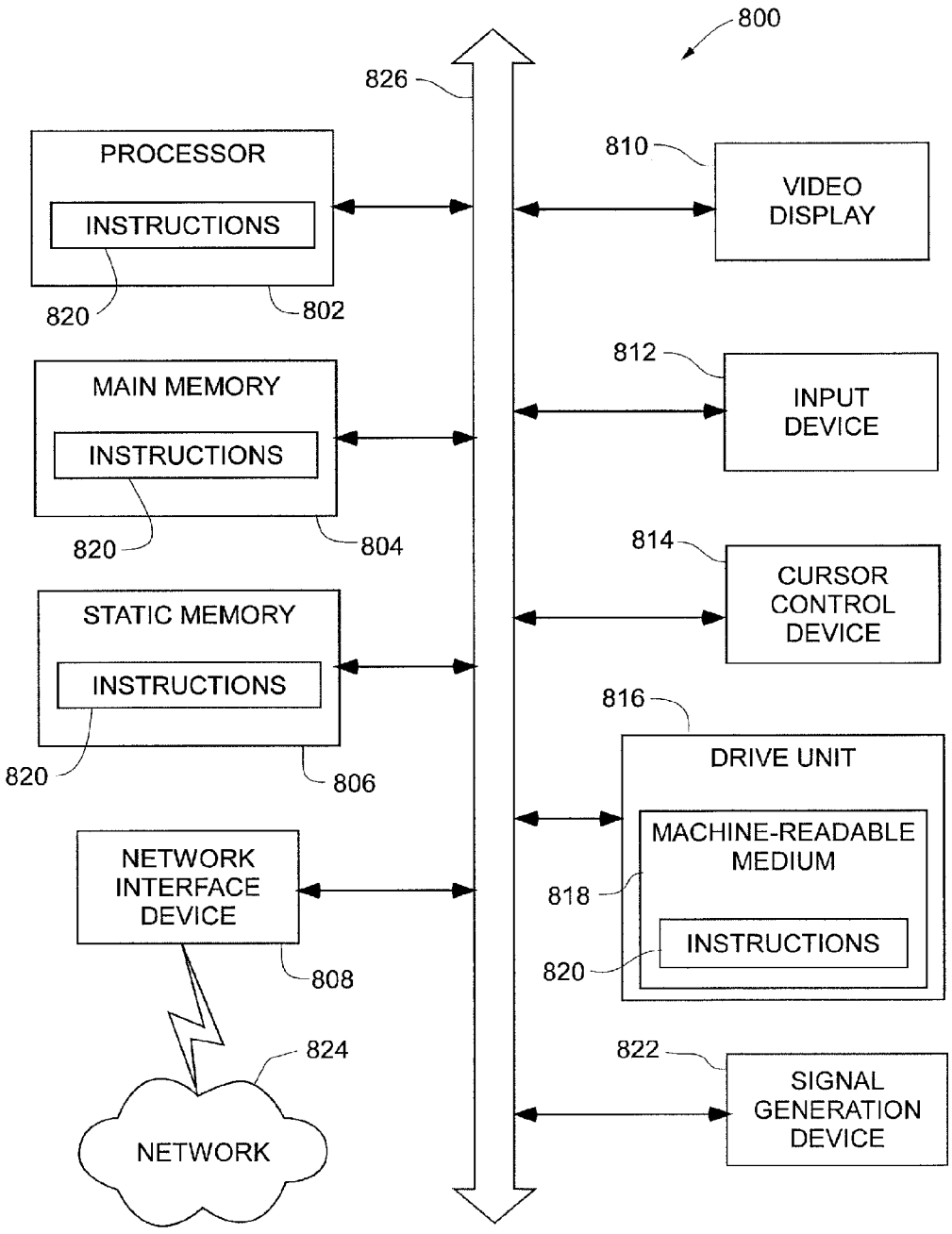

800
826
PROCESSOR
INSTRUCTIONS
820
802
MAIN MEMORY
INSTRUCTIONS
820
804
STATIC MEMORY
INSTRUCTIONS
820
806
NETWORK INTERFACE DEVICE
808
824
NETWORK
810
VIDEO DISPLAY
812
INPUT DEVICE
814
CURSOR CONTROL DEVICE
816
DRIVE UNIT
MACHINE-READABLE MEDIUM
818
INSTRUCTIONS
820
822
SIGNAL GENERATION DEVICE

Fig. 8

SYSTEM AND METHOD FOR CONTROLLING AN ADVANCING READING SLOT OF A READING AID AT VARIABLE VELOCITIES

BACKGROUND

1. Field

The present application relates generally to computerized reading aids. More specifically, the present application is directed to controlling a reading slot of the reading aid at variable velocities.

2. Brief Discussion of Related Art

Reading aids have been available to help readers, from new readers to experienced readers, increase fluency and speed. One type of reading aid is a mask having a reading slot. The mask obscures a portion of a reading passage that a reader intends to read, while a portion of text of the reading passage is exposed through the slot as the slot is advanced in relation to the reading passage. In a mechanical system, the text of the reading passage is provided on a physical page, and the reading slot is mechanically advanced over the text to expose the words to a reader viewing the page. In a projection system, the text of a reading passage is projected onto a screen by a projector. The projector further projects the mask over the text so that it is superimposed on the text. Here too, the slot is mechanically advanced to expose words to a reader that are projected on the screen.

In both the mechanical and projection systems, the reading slot has a fixed length dimension as it is advanced during a reading session in which a reader reads a reading passage. Additionally, the mask has a fixed opacity. More recently, computerized reading aids have become available that display text of a reading passage and a mask that overlays a portion of the text. Similar to the mechanical and projection systems, a reading slot is advanced in relation to the reading passage to help improve the reader's fluency and speed. Here too, the reading slot is advanced at a single velocity during a reading session, the length dimension of reading slot is fixed, and the mask has a fixed opacity.

Readers having varying abilities read at different speeds. Some readers can read faster than others, and some readers can beneficially use their peripheral vision to preview text of the reading passage that is ahead of their current reading position. However, for some readers, an exposure of too many words ahead of the current reading position will encourage a saccade too far to the right. In response, the reader may skip words and/or go back to a reading position to try and read missed words, losing speed and fluency. Thus, some readers may benefit by having less text exposed to their peripheral vision than more experienced readers.

Additionally, a reader of any skill level may read the middle of a line at a different velocity than when transitioning from one line of text to the next. A slot that is advanced at a single velocity throughout a reading passage can thwart a reader's ability to read faster or improve the reader's reading speed. Additionally, in a single reading passage, some types of text (e.g., dense, complicated reading material) may warrant a slower reading velocity than other text. Encouraging the reader to read at a single velocity can interfere with comprehension of text that warrants a slower reading velocity.

Accordingly, it is desirable to provide a configurable reading aid to train a reader to read at a velocity that it is appropriate for the particular reader, e.g., based on the reader's experience and ability. Further, it is desirable to provide a reading aid that also allows the reader to read at different velocities within the same or different reading passages. Additionally, it is desirable to control the exposure of text of a reading passage that can be visible to the reader, such as by the reader's peripheral vision.

SUMMARY

In accordance with an embodiment or aspect, a computerized method of controlling a reading slot to provide aid to a user in reading a passage is disclosed. The computerized method includes generating, by a processing device, a mask having an opaque portion and a reading slot. The opaque portion covers a plurality of lines having characters that are visible through the slot. The plurality of lines includes at least a first line and a second line. The method includes advancing, by the processing device, the slot at a midline velocity in relation to the first line of the passage, and increasing, by the processing device, the velocity of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage.

The method of controlling the reading slot can further include displaying the mask over the plurality of lines.

The method of controlling the reading slot can further include accessing a reading proficiency of the user.

The method of controlling the reading slot can further include determining an opacity level of the mask based on the reading proficiency of the user.

The method of controlling the reading slot can further include determining the midline velocity based on the reading proficiency of the user.

The method of controlling the reading slot can further include determining a length dimension of the slot based on the reading proficiency of the user.

The slot can include a translucent portion and a semi-opaque portion, and the method of controlling the reading slot can further include setting at least one of a length dimension of the semi-opaque portion and a degree of opaqueness of the semi-opaque portion based on the reading proficiency of the user.

The method of controlling the reading slot can further include determining when the slot enters the transition zone based on a marker associated with the first line of the passage.

The method of controlling the reading slot can further include increasing the velocity of at least one of the slot's lead and trail edges in accordance with the transition velocity profile such that a length dimension increases between the slot's lead and trail edges.

The method of controlling the reading slot can further include adjusting the velocity of the slot's lead and trail edges at different times.

The method of controlling the reading slot can further include decreasing the velocity of at least one of the slot's lead and trail edges in accordance with a digital recovery velocity profile when the slot exits the transition zone.

The method of controlling the reading slot can further include decreasing the velocity of at least one of the slot's lead and trail edges in accordance with the transition velocity profile such that a length dimension decreases between the slot's lead and trail edges, until the length dimension reaches a predetermined dimension.

The method of controlling the reading slot can further include determining when the slot exits the transition zone based on a marker associated with the second line of the passage.

The method of controlling the reading slot can further include adjusting at least one of the slot's position or advance-

ment based on a code related to the passage, wherein the code is embedded in the passage or is associated with the passage.

The method of controlling the reading slot can further include receiving a request to adjust one of a position of the slot, the velocity of the slot, and a velocity of at least one of a lead edge and trail edge of the slot. The method can further include adjusting at least one of the slot position, the velocity of the slot, and the velocity of the at least one of the lead edge and trail edge of the slot.

The method of controlling the reading slot can further include receiving feedback information from the user in response to the request to adjust. The method can further include adjusting, based on the feedback information, at least one of: a selected distance for the position of the slot, an amount for velocity of the slot, and an amount for the velocity of the at least one of the lead edge and trail edge of the slot.

In accordance with a further embodiment aspect, a system is disclosed to control a reading slot to provide aid to a user in reading a passage. The system includes a processing device and a memory device. The memory device stores instructions that, when executed by the processing device, cause the processing device to perform the following operations. The operations include generating a mask having an opaque portion and a reading slot. The opaque portion covers a plurality of lines having characters that are visible through the slot. The plurality of lines includes at least a first line and a second line. The operations further include advancing the slot at a midline velocity in relation to the first line of the passage, and increasing the velocity of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage.

The operations can further include displaying the mask over the plurality of lines.

The operations can further include accessing a reading proficiency of the user.

The operations can further include determining an opacity level of the mask based on the reading proficiency of the user.

The operations can further include determining the midline velocity based on the reading proficiency of the user.

The operations can further include determining a length dimension of the slot based on the reading proficiency of the user.

The slot can include a translucent portion and a semi-opaque portion. The operations can further include setting at least one of a length dimension of the semi-opaque portion and a degree of opaqueness of the semi-opaque portion based on the reading proficiency of the user.

The operations can further include determining when the slot enters the transition zone based on a marker associated with the first line of the passage.

The operations can further include increasing the velocity of at least one of the slot's lead and trail edges in accordance with the transition velocity profile such that a length dimension increases between the slot's lead and trail edges.

The operations can further include adjusting the velocity of the slot's lead and trail edges at different times.

The operations can further include decreasing the velocity of at least one of the slot's lead and trail edges in accordance with a digital recovery velocity profile when the slot exits the transition zone.

The operations can further include decreasing the velocity of at least one of the slot's lead and trail edges in accordance with the transition velocity profile such that a length dimension decreases between the slot's lead and trail edges, until the length dimension reaches a predetermined dimension.

The operations can further include determining when the slot exits the transition zone based on a marker associated with the second line of the passage.

The operations can further include adjusting at least one of the slot's position or advancement based on a code related to the passage, wherein the code is embedded in the passage or is associated with the passage.

The operations can further include receiving a request to adjust one of a position of the slot, the velocity of the slot, and a velocity of at least one of a lead edge and trail edge of the slot. The operations can further include adjusting at least one of the slot position, the velocity of the slot, and the velocity of at least one of the lead edge and trail edge of the slot.

The operations can further include receiving feedback information from the user in response to the request to adjust. The operations can further include adjusting, based on the feedback information, at least one of: a selected distance for the position of the slot, an amount for velocity of the slot, and an amount for the velocity of the at least one of the lead edge and trail edge of the slot.

In accordance with a still further embodiment aspect, a computer-readable medium storing instructions is disclosed that, when executed by the processor, cause the processor to perform operations to control a reading slot to provide aid to a user in reading a passage. The operations include generating a mask having an opaque portion and a reading slot. The opaque portion covers a plurality of lines having characters that are visible through the slot. The plurality of lines includes at least a first line and a second line. The operations further include advancing the slot at a midline velocity in relation to the first line of the passage, and increasing the velocity of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage.

The operations can further include displaying the mask over the plurality of lines.

The operations can further include accessing a reading proficiency of the user.

The operations can further include determining an opacity level of the mask based on the reading proficiency of the user.

The operations can further include determining the midline velocity based on the reading proficiency of the user.

The operations can further include determining a length dimension of the slot based on the reading proficiency of the user.

The slot can include a translucent portion and a semi-opaque portion. The operations can further include setting at least one of a length dimension of the semi-opaque portion and a degree of opaqueness of the semi-opaque portion based on the reading proficiency of the user.

The operations can further include determining when the slot enters the transition zone based on a marker associated with the first line of the passage.

The operations can further include increasing the velocity of at least one of the slot's lead and trail edges in accordance with the transition velocity profile such that a length dimension increases between the slot's lead and trail edges.

The operations can further include adjusting the velocity of the slot's lead and trail edges at different times.

The operations can further include decreasing the velocity of at least one of the slot's lead and trail edges in accordance with a digital recovery velocity profile when the slot exits the transition zone.

The operations can further include decreasing the velocity of at least one of the slot's lead and trail edges in accordance with the transition velocity profile such that a length dimension decreases between the slot's lead and trail edges, until the length dimension reaches a predetermined threshold.

The operations can further include determining when the slot exits the transition zone based on a marker associated with the second line of the passage.

The operations can further include adjusting at least one of the slot's position or advancement based on a code related to the passage, wherein the code is embedded in the passage or is associated with the passage.

The operations can further include receiving a request to adjust one of a position of the slot, the velocity of the slot, and a velocity of at least one of a lead edge or trail edge of the slot. The operations can further include adjusting at least one of the slot position, the velocity of the slot, and the velocity of at least one of the lead edge and trail edge of the slot.

The operations can further include receiving feedback information from the user in response to the request to adjust. The operations can further include adjusting, based on the feedback information, at least one of: a selected distance for the position of the slot, an amount for velocity of the slot, and an amount for the velocity of the at least one of the lead edge and trail edge of the slot.

These and other purposes, goals and advantages of the present application will become apparent from the following detailed description read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments or aspects are illustrated by way of example and not limitation in the figures of the accompanying drawings in which:

FIG. **1** illustrates an example reading aid system having an advancing reading slot;

FIGS. **2**A-**2**E illustrate an example mask with a reading slot displayed in relations to a reading passage;

FIG. **3** illustrates another embodiment of the reading slot shown in FIG. **2**A;

FIG. **4** illustrates velocity profiles of edges of the reading slot shown in FIG. **2**A;

FIG. **5** illustrates a graphical user interface displayed by the reading aid system shown in FIG. **1**;

FIG. **6** illustrates a reading passage having embedded codes;

FIGS. **7**A and **7**B show a flowchart that illustrates an example method of the reading aid system shown in FIG. **1**; and

FIG. **8** is a block diagram of an illustrative embodiment of a general computer system.

DETAILED DESCRIPTION

A system and method to control advancement of a reading slot of a computerized reading aid are disclosed herein. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of example embodiments or aspects. It will be evident, however, to one skilled in the art, that an example embodiment may be practiced without all of the disclosed specific details.

The computerized reading aid provides a mask that overlays a reading passage having a plurality of characters. The mask includes an opaque portion that occludes some of the characters of the reading passage, and a transparent slot through which other characters of the reading passage are visible. The slot is advanced in relation to, e.g., along, a line of characters. The velocity at which the slot advances and the length of the slot can vary. The velocity at which the slot is advanced can be increased when the slot reaches the end of the line and transitions to a next line. Additionally, the length of the slot can be increased when the slot reaches the end of the line and transitions to a next line.

More specifically, the slot is advanced along a line of characters at a midline velocity until it encounters (e.g., enters) a transition zone when it begins to transition from a first line to a second line. When the slot enters the transition zone on the first line, the velocity of at least one of the slot's lead and trail edges can be increased. The timing and velocity changes during the transition can be determined from a digital transition velocity profile. When the slot exits the transition zone on the second line (e.g., an edge of the slot encounters an end of the transition zone), the velocity of at least one of its lead and trail edges can be changed so that the slot can resume advancing at its midline velocity and return to its midline length. The timing and velocity changes during the recovery from transition velocity to midline velocity can be determined from a digital recovery velocity profile.

Parameters of the mask can be selected in accordance with an assessment of the proficiency of the reader. Selectable parameters can include dimensions of the mask, a length dimension of the slot (e.g., the distance between a trail edge and a lead edge of the slot), the slot's midline velocity, the slot's velocity transition profile, the slot's recovery profile, and the location of markers that define the transition zone.

FIG. **1** illustrates an example reading aid system **100**. The example system **100** includes at least one computing device **102** that can be operated by a user. A user can be an administrator **101** (e.g., a teacher, principal, or network administrator) or a reader **103** (e.g., a student). An administrator can, for example, use the computing device **102** to configure the computing device **102**, to configure a profile for a reader **103** or to retrieve results about one or more readers **103**. A reader **103** can, for example, use the computing device **102** as a reading aid to train while reading a passage using the mask and advancing reading slot.

In some embodiments, the system **100** can also include a server **106**, a reading passage database **108**, a user database **110**, and communication network **112**. The communication network **112** can enable communication among the computing devices **102**, server **106**, reading passage database **108**, and/or user database **110**.

The communication network **112** can include one or more of a long haul transport network (e.g., gigabit Ethernet network, Asynchronous Transfer Mode (ATM) network, frame relay network), wireless network (e.g., satellite network, Wi-Fi network, cellular network, or another wireless network), other public or private networks, or any combination thereof. The foregoing is not exhaustive and alternate or additional communication networks can be employed to interconnect the computing devices **102**, server **106**, reading passage database **108**, and/or user database **110**.

The communication network **112** can include one or more of a wide area network (WAN), local area network (LAN), virtual private network (VPN), peer-to-peer (P2P) network, as well as any other public or private network (e.g., the Internet), or any combination thereof. Other conventional or yet to be developed communications networks can form at least a part of the communication network **112**. At least a portion of the transmission over the communication network **112** can be accomplished, for example, via Transfer Control Protocol/Internet Protocol (TCP/IP), User Datagram Protocol (UDP)/IP, or any combination of conventional protocols or yet to be developed protocols. The computing devices **102** can communicate with other systems and devices illustrated in FIG. **1**, whether directly and/or using one or more networks, such as network **112**.

The computing device **102** can be a personal computer (e.g., desktop or laptop), tablet computing device, a smart phone, a smart device, or a computer terminal of a network of computing devices, etc. The computing device **102** can operate as a standalone device that can operate without communicating with the network **112**. Alternatively, the computing device **102** can communicate with other devices via the communication network **112**, such as other computing devices **102**, the server **106**, the reading passage database **108**, and/or the user database **110**. The computing device **102** can store and execute a web browser for accessing and exchanging information with server **106** and other devices via the communication network **112**.

The computing device **102** includes and/or accesses at least one storage device and a processor that performs operations in accordance with execution of instructions provided by reading aid ("aid") unit **104**. The computing device **102** has a display device that can present a graphical user interface (GUI) to display one or more reading passages for training the user to read with better fluency at a greater speed. The GUI displays information to the user and can be used to input information to the computing device **102**. Information can be input using a one or more devices of the computing device **102**, such as a touch screen, a cursor control device (e.g., a mouse, touchpad, or joystick), a keypad, and/or keyboard.

The reading aid unit **104** includes a reading passage display unit **120**, a slot generation unit **122**, a slot advancement unit **124**, a user interaction unit **126**, a code recognition unit **128**, a level selection unit **130**, and a report generator unit **132**.

In some embodiments, the reading aid unit **104** is stored and executed locally by a computing device **102** that displays a mask with reading slot in relation to (e.g., over) a selected reading passage. The term "locally," as used herein, refers to an act that is performed by a component that is integrated with the computing device **102** or server **106**. The term "integrated," as used herein, refers to being included within, inserted into (e.g., via a port), or otherwise physically associated with the referenced device. Accordingly, all or a portion of the reading aid unit **104** can be executed and performed locally by the computing device **102**. In another embodiment, the reading aid unit **104**, or a portion of the reading aid unit **104**, is stored, provided, and executed remotely by the server **106**. The term "remotely," as used herein, refers to being connected to a device by a wired and/or wireless connection, e.g., a cable or a network. Thus, all or a portion of the reading aid unit **104** can be executed and performed remotely by the server **106**. For example, the server **106** can generate the mask and control advancement of the slot during a reading session, while the mask and the slot are displayed over a reading passage displayed by the computing device **102**.

One or more of the units **120-132** of reading aid unit **104** can be transmitted via communication **112** from the server **106** to the computing device **102**, e.g., for the computing device **102** to store and execute locally. Additionally, reading aid unit **104** can be configured as an "app" that is downloaded and stored by tablets, smart devices, phones, and the like. The units **120-132** of reading aid unit **104** are described in greater detail below.

The server **106** can be a computer such as a network server or a web server that processes requests and delivers data to other computing devices **102**, e.g., in accordance with a server/client relationship via communication network **112**. Moreover, server **106** can communicate with the browsers of the computing devices **102**, e.g., to send one or more web pages to a requesting computing device **102**, and to exchange information via the webpages. As a web server, server **106** can further communicate with the web browser and reading aid unit **104** of one or more of the computing devices **102** using one or more communication protocols, such as Hyper Text Transfer Protocol (HTTP).

The server **106** can transmit display information to the computing device **102** for generating or providing information to the GUI for display by the computing device **102**. Additionally or alternatively, the server **106** can receive information input from the user via the GUI. The GUI used to exchange information between the computing device **102** and the server **106** can include one or more webpages.

The reading passage database **108** and user database **110** can include one or more databases stored on one or more storage devices that can be integrated with or be remote from the computing device **102** or the server **106**. The reading passage database **108** stores reading material including a plurality of reading passages having text that can be displayed on the display device of the computing device **102**. The reading passage database **108** or portions thereof can be stored locally by a computing device **102**, by a network (e.g., an intranet) of computing devices **102**, and/or by server **106**.

The reading passages can include additional components, such as images, graphics, symbols, tables, embedded codes, etc. The text in a reading passage can precede, follow, overlay, underlie, or wrap around the additional components. The text in the passage can include readable characters, such as alphanumeric characters (e.g., including the "space" character), kana or kanji, mathematical operators, symbols, emoticons, and/or other characters that are readable, e.g., associated with a predefined meaning alone or in combination with other characters. A reading passage can be selected, automatically or by a user, from a plurality of passages and retrieved from the reading passage database **108**, such as based on information associated with the reading passage (e.g., reading difficulty level, genre, subject area, title, searchable word or phrase, and/or author). The plurality of passages from which a user is allowed to select a reading passage can be limited based on the user's profile (e.g., which can include the user's grade level, teacher, class, favorite subject areas, etc.).

The text in a passage can be formed in lines that have a beginning and an end. The lines can be oriented horizontally or vertically, and the text in the passage can be read left-to-right, right-to-left, top-to-bottom, or bottom-to-top. In the examples that follow, the text is set forth in lines, left-to-right, for conciseness and clarity. The text in the passage can be formatted, for example, in paragraphs, columns (e.g., a newspaper or magazine article), tables, charts, with one or more margins that vary within the passage. The length of different lines in the passage can vary.

The user database **110** stores information relating to users of the reading aid unit **104**. The user database **110** can include a list of users who use reading aid unit **104**, and associated user profiles. The user profiles can indicate a group or subgroup that a user is associated with, such as a school district, town, school, grade, classroom, etc. Access to information about the users can be limited by requiring entry of authorization data, such as a username and passcode. The user database **110** or portions thereof can be stored locally by a computing device **102**, by a network (e.g., an intranet) of computing devices **102**, and/or by server **106**.

Information stored about a reader can include reading proficiency assessment information; previously generated reports associated with use of the reading aid unit **104**; reading preferences, such as favorite subjects for reading material; and reading proficiency goals.

The units **120-132** of reading aid unit **104** are now described. Reading passage display unit **120** enables a user to select a reading passage from the reading passage database

108 and displays the selected reading passage in a GUI of the computing device 102. Slot generation unit 122 generates a mask and a slot according to one or more parameters, and displays the mask and slot in the GUI by overlaying the mask and slot in relation to (e.g., over) the reading passage. The mask includes one or more opaque portions and a slot portion (e.g., slot). The opaque portion of the mask obscures one or more reading portions underneath that are not visible or are partially visible. Portions of the reading passage under partially translucent portions of the mask have reduced visibility that can be varied based on a degree of opaqueness, e.g., an opaqueness percentage. The clarity of the visibility is decreased with higher percentage of opaqueness. The slot of the mask allows a reading portion under the mask to be visible through the slot, which is a translucent portion of the mask.

The mask parameters can be determined based on reading proficiency assessment information stored for the reader. The mask parameters can also be determined based on characteristics of the reading passage, such as a font size of the characters and reading difficulty level of the selected reading passage. In some embodiments, one or more of the mask parameters can be selected by an administrator having administrative privileges. Mask parameters can also be adjusted based on user feedback information.

Slot advancement unit 124 controls advancement of the slot in relation to (e.g., along) the displayed lines of text of the passage, including controlling transition of the slot from one line of text in a passage to a next line of text in the passage. User interaction unit 126 interacts with the reader before, during, and/or after a reading session to exchange information between the user and reading aid unit 104 about a reading session. The user interaction unit 126 receives information input by a user via a user control tool (e.g., user control panel 504 in FIG. 5) associated with the GUI displaying a masked reading passage. The user interaction unit 126 can further request and/or receive feedback information from the user during or after a reading session, such as via a pop-up window. Additionally, the user interaction unit 126 can generate feedback information reporting the reader's performance during the reading session and use of the user control tool 504. The advancement of the slot as controlled by the advancement unit 124 can be adjusted in response to the feedback information.

Code recognition unit 128 recognizes codes that are included in (e.g., embedded) or otherwise related to the reading passage. It uses information provided by the codes to control one or more aspects of the reading session, such as the mask parameters. Level selection unit 130 selects a student's reading proficiency level based on the student's performance during reading sessions using the reading aid unit 104, information input by a user (e.g., a teacher), reading assessment results, and results generated by user interaction unit 126. Report generator unit 132 generates reports about readers and their performance using the reading aid unit 104. Reports can be generated for groups of readers, such as grouped by classroom, teacher, school grade, school, school district, gender, socio-economic level, etc.

FIG. 2A shows a window 202 of a GUI (e.g., GUI 500 shown in FIG. 5) in which a selected reading passage is displayed. A mask 204 is generated and displayed in relation to (e.g., over) the selected reading passage in a direction 214. The mask 204 overlays the reading passage so that the reading passage is underneath the mask. The mask 204 has an opaque section 206 and a reading slot 208 through which characters 210 included in the reading passage are visible. The slot 208 is shown in a first position. During a reading session, the slot 208 is advanced in relation to (e.g., along) a plurality of lines of the reading passage, e.g., sequentially. The direction 214 can vary based on language. The velocity at which the slot 208 is advanced depends upon the position of the slot 208 on the line it is positioned on (referred to as "the current line"). For example, the velocity at which the slot 208 is advanced can be increased or decreased based on a position of the slot 208 on one or more of the lines relative to one or more markers.

Each marker can be generated based on a distance or time measurement. The distance can be measured, for example, by the number of characters or words, or by units, such as, inches, centimeters, pixels, points, pica, or another measurement. The distance can be measured, for example, relative to a beginning or end position of one of the lines of the reading passage, a first or last character of the line, or another marker. Time can be measured by units, such as seconds. The time can be measured, for example, relative to a time that the reading session began or relative to an expected time to advance to another position in the reading passage or marker using a selected velocity (e.g., the slot's current velocity) or another measurement.

In an embodiment, velocity of the slot 208 is increased or decreased based on the slot's position relative to a transition zone 216. A first marker 220 marks the beginning of the transition zone 216, and a second marker 222 marks the end of the transition zone 216. The slot 208 advances in direction 214 through the transition zone 216 when it transitions from one of the lines of the reading passage (e.g., a first or current line 212) to another of the lines of the reading passage (e.g., a second or next line 213).

The slot 208 has a lead edge 230 and a trail edge 232. The slot 208 has a length, which is a distance between the lead edge 230 and the trail edge 232. The slot 208 is shown advancing during a midline (ML) phase before it enters the transition zone 216 (see FIG. 4, ML phase 410). During the ML phase, the slot 208 advances at a midline velocity V_{ML}, and has a midline length L_{ML}. Midline refers to the middle of a line, e.g., not the transition zone 216 associated with the line. The ML phase can also include the beginning of a line that falls within the transition zone 216, such as at the beginning of the reading passage when the slot 208 first begins advancing and is not transitioning among lines.

The reading aid unit 104 can help the reader to improve reading speed and fluency when transitioning from a first line of text in a passage (in the current example, line 212) to a second line of text in the passage (in the current example, line 213) by increasing the velocity of the slot 208 when it advances in relation to the transition zone 216 associated with the first and second lines 212, 213. In one embodiment, the velocity is increased in accordance with a transition velocity profile. In order for the slot 208 to return to advancing at its midline velocity V_{ML}, the velocity of the slot 208 is changed in accordance with a recovery velocity profile.

In an embodiment, the velocities of the lead edge 230 and trail edge 232 are increased and/or decreased at the same time and by the same magnitude. As a result, the length of the slot 208 does not change during transition among lines, e.g., as the slot 208 advances in relation to transition zones.

In another embodiment, the velocities of the lead edge 230 and trail edge 232 are increased or decreased at different times and/or by different magnitudes in accordance with the transition velocity profile or the recovery velocity profile. As a result, the length of the slot 208 changes while the slot 208 advances in relation to the transition zone 216.

The respective parameters of the mask 204 can be predetermined, selectable by an administrator 101 accessing an reading aid unit 104 of a computing device 102, selectable by a reader 103 using the computing device 102, selectable auto-

matically in accordance with results of an assessment of the reader's proficiency (e.g., reading rate and span of recognition at the reading rate), selectable by performance, adjusted in response to feedback information associated with the current or previous reading sessions, and/or determined based on the setting of one or more other mask parameters. A list and description of example mask parameters is provided as follows.

The dimensions of the mask **204** are parameters that can be defined in accordance with the dimensions of the window **202** and/or the layout or format of the text of the reading passage displayed in the window **202**.

The margins of the mask **204** and margins that define the beginning and end of the plurality of lines can be selected by an administrator **101** or determined automatically from the reading passage, e.g., according to predefined margins associated with the reading passage. For example, the margins or layout of the reading passage can be accessed and used to determine the margins of the mask or layout of the plurality of lines of text in the passage that the slot will advance along. The margins and layout can also be determined based on information included in embedded codes included in the reading passage.

L_{ML} is the slot's **208** midline length. This is the distance between the lead edge **230** and the trail edge **232** when the slot **208** is not transitioning between lines. L_{ML} is measured by units that can be predetermined or selectable. The units can be, for example, inches, centimeters, pixels, points (1/72.272 inch), pica (pc) (⅙th of an inch), or another unit. L_{ML} can alternatively be measured by the number of characters or the number of words between the lead edge **230** and the trail edge **232**.

L_{ML} can be defined, for example, based on the reading proficiency of the reader, and particularly the reader's average span of recognition at the midline velocity V_{ML} of the slot **208**. In one example, L_{ML} is selected so that at least 7-8 characters are exposed within the slot **208**, which accommodates the average span of recognition of most readers. Information about the reader's span of recognition can be included with result data obtained from assessments administered to the reader that assess the reader's reading proficiency and span of recognition. Since the reader's span of recognition can vary with different reading speeds, the L_{ML} of the slot **208** can be selected to be longer in accordance with a higher selected V_{ML}, and shorter when the V_{ML} is selected to be lower. By providing a suitable L_{ML} for the reader based on the reader's reading proficiency and the V_{ML}, the reader can have effective visual contact with words exposed on each line through the slot **208** without exposure to too many words. Exposure to too many words can encourage a saccade, e.g., in the direction of advancement that is too far ahead. Such a saccade can result in the reader missing words, or excessive regressions in which the reader returns focus to text in the passage that the reader missed due to a saccade that was too far in advance.

The first marker **220** is a marker that marks the beginning of the transition zone **216** for a plurality of lines of a reading passage. The transition zone **216** includes the end portion of a line, e.g., first line **212**, and the beginning portion of the next line, e.g., second line **213**, to transition the reading slot **208** from line to line. The first marker **220** can be different for each of the plurality of lines, since the length of text on a line can vary. For example, the length of text on the last line of a paragraph may be shorter than for a line in the middle of the paragraph. The first marker **220** can be positioned in terms of distance, e.g., a distance from a margin, the end of a line (e.g., the last character or word of text on the line), or from the second marker **222**. The distance can be measured, for example, by the number of characters or words, or by units, such as, inches, centimeters, pixels, points, or pica. Alternatively, the first marker **220** can be measured in terms of time, e.g., as a time interval (e.g., measured in seconds) before slot **208** encounters a margin, the end of the text on a line (e.g., the last character or word of text on the line), or the second marker **222**, (e.g., determined using V_{ML} or a different selected velocity).

The term "encounter," as used herein with reference to the slot **208** encountering an entity associated with the reading passage or the mask, such as a margin or a marker, refers to a determination that the position of the slot **208** (e.g., its lead edge **230**, trail edge **232**, midpoint) has a predetermined relation relative to the position of the entity. The predetermined relation can include, for example, having the same position, such as when the slot **208** (or its lead edge **230**) reaches the entity. In another example, the predetermined relation can include having a position a predetermined distance (e.g., measured as by the number of pixels, points, or pica, characters or words, or by units, such as, inches, centimeters) in a predetermined direction relative to the entity, such as when the slot passes the entity.

The second marker **222** is a marker of the end of the transition zone **216** for the plurality of lines of the reading passage, which is when the reading slot **208** recovers from transitioning to a next line, e.g., second line **213**. The second marker **222** can be different for each of the plurality of lines, since the length of a line of text in a passage can vary, such as for the first line of a paragraph in which the text is indented. The second marker **222** can be positioned in terms of distance, e.g., a distance from a margin, the first character or word of text on the line, or the distance from the first marker **220**. The distance can be measured, for example, by the number of characters or words, or by units, such as, inches, centimeters, pixels, points, or pica. Alternatively, the second marker **222** can be measured in terms of time, e.g., as a time interval (e.g., measured in seconds) after slot **208** encounters a margin, the beginning of the text on a line (e.g., the first character or word of text on the line), or the second marker **222** (e.g., determined using V_{ML} or a different selected velocity).

L_{TZ} is the length of the transition zone **216**, which is the distance between the first marker **220** and the second marker **222**. Of the three parameters, the first marker **220**, the second marker **222**, and L_{TZ}, two of these parameters can be selected or determined, which can cause determination of the third parameter.

The first marker **220**, the second marker **222**, and/or L_{TZ} can be selected or determined based on the reader's reading proficiency, the V_{ML}, and/or the velocities of the lead and trail edges **230** and **232** during transition or recovery. For example, L_{TZ} can be selected to be longer for an experienced reader that reads at a faster rate than a slower reader. A longer L_{TZ} provides the advantage of exposing more characters that lie in the reader's advance peripheral vision during a transition from line to line of a reading passage. However, for a slower reader, an L_{TZ} that is too long can cause a distraction or encourage saccades that interfere with reading fluency.

V_{ML} is the slot's **208** midline velocity when the slot **208** is not transitioning between lines. V_{ML} is measured by a ratio of distance (e.g., inches, centimeters, pixels, points, pica, or number of characters or words) and time unit (e.g., seconds).

P_{VT} is the slot's **208** velocity transition profile. P_{VT} describes the timing and changes in velocity of the lead edge **230** and trail edge **232** of the slot **208** from the time the lead

edge **230** enters the transition zone **216** on line **212** until the lead edge **230** exits the transition zone **216** on line **213**.

Entering the transition zone **216**, as used herein, refers to encountering the transition zone **216**. In an embodiment, the slot **208** encounters the transition zone **216** when its lead edge **230** encounters the beginning of the transition zone **216**, e.g., the first marker **220**. Exiting the transition zone **216** herein refers to a termination of the encounter with the transition zone **216**. In an embodiment, the slot terminates its encounter with the transition zone **216** when its lead edge **230** encounters the end of the transition zone **216**, e.g., the second marker **222**.

P_{VT} is selected so that when the lead edge **230** encounters the first marker **220**, the velocity of the slot's lead edge **230** and trail edge **232** are increased (e.g., to $>V_{ML}$, either together or one at a time), as the slot **208** transitions to line **213**. In this way, the reader is trained to increase his/her reading rate when transitioning from one line to the next line. The timing when to change the velocity, and the amount by which the velocity is changed, are each selectable, e.g., by a user or automatically, such as in accordance with the user's profile or characteristics of the reading passage.

In one embodiment, the lead edge **230** and trail edge **232** increase at the same time and by the same amount so that the length of the slot **208** L_{ML} remains constant as the slot **208** advances in relation to line **212**, transitions to the next line **213**, and continues to advance along line **213**.

In one embodiment, the trail edge **232** increases its velocity before the lead edge **230** does, in order to cue the reader to move his/her focus more quickly to the next line.

In another embodiment, the velocity of the lead edge **230** is increased during transition to the next line **213** without increasing the velocity of trail edge **232**. This configuration causes the length of the slot to increase so that it is greater than L_{ML}.

In still another embodiment, the velocity of both the lead edge **230** and the trail edge **232** are increased, but the velocity of lead edge **230** is increased by a greater amount than the velocity of trail edge **232**.

The increases in velocity can be, for example, performed in incremental steps, continual, or in a single step. P_{VT} is described in greater detail below with reference to FIG. **4**.

P_{VR} is the slot's **208** velocity recovery profile. P_{VR} describes the timing and changes in velocity of the lead edge **230** and trail edge **232** during a recovery phase after the slot **208** transitions from one line to the next line.

P_{VR} is selected so that when the lead edge **230** exits the transition zone **216** on the second line **213**, the velocities of the slot's lead edge **230** and trail edge **232** are decreased (e.g., until they equal V_{ML}) as the slot **208** continues to advance in relation to the second line **213**. Depending on the embodiment described above, the velocities can be decreased by same or different amounts. In this way, the reader resumes reading at the reader's midline reading velocity. The timing when to change the velocity, and the amount by which the velocity is changed, are selectable, e.g., by a user or automatically, such as in accordance with the user's profile or characteristics of the reading passage.

In one embodiment, the velocities of the lead edge **230** and trail edge **232** decrease at the same time and by the same amount, so that the length of L_{ML} the slot **208** remains constant as the slot **208** continues to advance along the second line **213**.

In another embodiment, the lead edge **230** decreases its velocity to V_{ML}. The velocity of the trail edge **232** continues at its increased velocity (e.g., per the velocity transition profile P_{VT}), until the length of the slot **208** returns to the midline length L_{ML}. At that point, the velocity of the trail edge **232** decreases to V_{ML}.

In another embodiment, the lead edge **230** decreases its velocity to V_{ML}. The velocity of the trail edge **232** is increased to a velocity that is greater than its velocity during transition, until the length of the slot **208** returns to the midline length, L_{ML}. At that point, the velocity of the trail edge **232** decreases to V_{ML}.

In still another embodiment, the velocity of both the lead edge **230** and the trail edge **232** are decreased, but the velocity of lead edge **230** is decreased by a greater amount than the velocity of trail edge **232**.

The increases and decreases in velocity can be, for example, performed in incremental steps, continual, or in a single step. P_{VR} is described in greater detail below with reference to FIG. **4**.

O_M is the opacity of the mask **204**. The opacity can be selectable, such as based on the reading proficiency of the reader. For example, O_M can be selected to be 100% opaque so that the mask **204** fully obscures all text in the passage other than the text that is exposed through the reading slot **208**. This opacity setting can be selected for a beginning reader or slow reader (e.g., having a reading rate of less than 360 wpm). This selection may be for the purpose of training the reader to advance his/her visual focus along sequential lines for encouraging sequential fixation. The reader thus can train to read the passage by repeatedly visually tracking the slot **208** as it advances, e.g., along a line **212** and transitions to the beginning of the next line in sequence.

Partial opacity of mask **204** (e.g., O_M=30%-70%) can be selected for readers having reading rates faster than 360 wpm, with a lower percentage of opacity used for faster readers. By providing less opacity, the words that are outside of the slot **208** but covered by the opaque portion **206** of the mask **204** are partially visible. Faster readers can use more of their advance peripheral vision to read text in the passage that is ahead of the advancing slot **208** (e.g., right peripheral vision when reading from left-to-right). An experienced reader can use advance peripheral vision to obtain orthographic information for anticipating upcoming words and a landing position for the reader's next visual fixation. However, such advance peripheral vision can be detrimental to a less experienced reader, causing a distraction and encouraging saccades that interfere with fluency and speed in reading.

FIG. **2**B shows slot **208** at a second position, in phase T**1** (see FIG. **4**, phase T**1** **416**), in which the lead edge **230** has just encountered the first marker **220**. This indicates that the slot **208** has entered the transition zone **216** and is beginning a transition operation to transition from line **212** to the next line **213**. During phase T**1**, the slot **208** advances in accordance with the slot's **208** velocity transition profile P_{VT}. During phase T**1** the velocity of the slot's trail edge **232** can be increased, cueing the reader that the transition operation is beginning. The length of slot **208** during phase T**1** is L_{T1}, which is slightly shorter than L_{ML}.

FIG. **2**C shows slot **208** at a third position, in phase T**2** (see FIG. **4**, phase T**2** **418**), in which the velocity of the lead edge **230** is increased, as the slot **208** continues to advance in accordance with the slot's **208** velocity transition profile P_{VT}. In the example shown, during phase T**2**, the velocity of the lead edge **230** exceeds the velocity of the trail edge **232**, causing the length of the slot **208** to increase. The length of slot **208** during phase T**2** is L_{T2}, which is longer than L_{ML}.

Phase T**1** and T**2** are both included in the transition phase T (see FIG. **4**, phase T **412**). The order and degree in which the

lead edge **230** and trail edge **232** increase in velocity can be selected as described herein, among other possible alternatives.

FIG. **2**D shows slot **208** advancing at a fourth position, in recovery phase R (see FIG. **4**, phase R **414**), in which the lead edge **230** has just encountered the second marker **222**. This indicates that the slot **208** is exiting the transition zone **216** and is completing the transition operation. During phase R, the slot **208** advances in accordance with the slot's **208** recovery transition profile P_{VR}. During phase R, the velocity of the slot's lead edge **230** is decreased to V_{ML}, while the trail edge **232** continues to advance at its increased velocity, causing the length of the slot **208** to decrease. The length of slot **208**, shown as L_R, continues to decrease until it returns to L_{ML}.

In an embodiment, the velocity of slot's trail edge **232** can be increased during phase R, hastening the return of the slot's length to L_{ML}. The order and degree in which the lead edge **230** and trail edge **232** decrease or increase in velocity can be selected as described herein, among other possible alternatives.

FIG. **2**E shows slot **208** in connection with line **213** once the length of slot **208** has returned to L_{ML} and the velocity of the lead edge **230** and trail edge **232** have both returned to the midline velocity V_{ML}, Advancement of the slot **208** has thus returned to phase ML on line **213**.

FIG. **3** shows slot **208** having a translucent portion **302** and an opaque portion **304**. The length L_{STP} of the slot's translucent portion **302**, the length L_{SOP} of the slot's opaque portion **304**, and the opacity of the slot's opaque portion **304** can be selected. In this way, the amount of advance peripheral vision available to the reader can be controlled in terms of its length and visibility to the reader. In some embodiments, the slot **208** can have multiple opaque portions **304**, each having a selectable length and opacity. These selections can be made in accordance with the reader's reading proficiency (e.g., reading rate and span of recognition at the reading rate) and/or the velocity of the slot **208**, e.g., V_{ML}, P_{VT}, and P_{VR}.

FIG. **4** includes a timing diagram **400** during a transition operation from line to line that includes an example timing curve **402** of velocity profiles of the slot's lead edge **230** and an example timing curve **404** of velocity profiles of the slot's trail edge **232**. The timing curves **402** and **404** show, for the lead edge **230** and the trail edge **232**, respectively, the midline velocity during a midline phase **410** of a first (or current) line, the velocity transition profile P_{VT} during a transition phase **412**, and the velocity recovery profile P_{VR} during a recovery phase **414**, back to midline velocity during midline phase **410** of a second (or next) line.

The timing diagram begins during the midline phase **410** at time **420**, during which the lead edge **230** and the trail edge **232** are both advancing along the first line **212** at the same midline velocity V_{ML}. At time **422**, the lead edge **230** encounters the first marker **220** on the first line **212**, and thus enters the transition zone **216**, beginning the transition phase **412** of the transition operation.

During the transition phase **412**, the lead edge **230** and trail edge **232** advance in accordance with the transition velocity profile P_{VT}. In the example shown, at time **422**, the velocity of trail edge **232** increases in accordance with transition velocity V_{TTE}, causing the opaque portion **206** of mask **204** to quickly obscure the text at the first line **212**. This prompts the reader to move his/her focus quickly to the beginning of the second (or next) line **213**.

At time **424**, the velocity of lead edge **230** increases in accordance with transition velocity V_{TLE}, wherein $V_{TLE} > V_{TTE}$. Since the lead edge **230** is advancing at a faster rate than the trail edge **232**, the length of the slot **208** increases, exposing the beginning of the next line **213**, encouraging the reader to rapidly continue reading on the next line **213**. The lead edge **230** continues to increase its velocity in accordance with V_{TLE} until it encounters the second marker **222** on the next line **213**, and thus exits the transition zone **216**, beginning the recovery phase **414** of the transition operation.

During the recovery phase **414**, the lead edge **230** and trail edge **232** advance in accordance with the recovery velocity profile P_{VR}. In the example shown, at time **426**, the velocity of lead edge **230** decreases in accordance with recovery velocity V_{RLE}, until it returns to its midline velocity V_{ML}, which occurs at time **428**. During the recovery phase **414**, trail edge **232** continues to advance at its increased transition velocity V_{TTE}, which is faster than the lead edge **230**, causing the length of the slot **208** to decrease. The recovery phase **414** continues, with the length of the slot **208** decreasing, until the length of the slot **208** returns to approximately the midline length L_{ML}, which occurs at time **430**.

At time **430**, the velocity trail edge **232** is decreased in accordance with recovery velocity V_{RTE} to its midline velocity V_{ML}. During the interval between time **430** and time **432** the length of the slot **208** decreases at a reduced rate relative to the time period between time **428** and time **430**, until it reaches the midline length L_{ML} Once the trail edge **232** has returned to its midline velocity V_{ML} and the slot's length has returned to the midline length L_{ML}, which occurs at time **432**, the recovery phase **414** is ended. Thus, at time **432**, operation returns to the midline phase **410** on line **213** and both the lead edge **230** and the trail edge **232** advance at the midline velocity V_{ML}, with the slot's length maintained at L_{ML}. The midline phase **410** continues until the lead edge **230** encounters the first marker **220** on line **213**, beginning another transition operation to advance to a next line.

FIG. **5** shows a GUI **500** displayed by reading aid unit **104** on a computing device **102** operated by a user. The user can be, for example, a reader, such as a student, teacher, or administrator. The teacher or administrator can administer use of the reading aid system **100** for one or more students.

The GUI **500** includes window **202** in which a reading passage is displayed with a mask **204** having an advancing slot **208** displayed over the reading passage. The GUI **500** further includes menu **502** and user control panel **504**.

The menu **502** includes a plurality of menu entries, including, for example, Select Reading Passage **510**, Level Selection **512**, Select Class or Student **514**, Generate or View Reports **516**, Request Testing **518**, and Testing Results **520**. Activation of the menu entries **510**-**520** can provide the user with a selected function or a submenu which provides the user with additional entries. Some or all of the menu entries **510**-**520** and/or their submenus can be disabled, or provided with limited selection options, depending upon an authorization level of the user. The authorization level can be determined when the user accesses the reading aid unit **104**, such as by a logon procedure. For example, a teacher can have access to information about his/her students and can select the reading passage and adjust levels for his/her students. A student may not have the authority to select a level, but can have access to a portion of the reading passages that fit certain criteria established by the teacher (such as the grade level of the reading passage).

Selection of the entry "Select Reading Passage" **510** can provide an example submenu **522**, which allows the user to interact with reading passage display unit **120** of reading aid unit **104** to select a reading passage. The submenu **522** can present categories for the user to select from, including genre (e.g., reference, media articles, textbook, fiction, non-fiction,

biography, or autobiography), level (e.g., grade level or difficulty level), subject (e.g., history, science, geography, business), title, or author. The teacher can choose to select the reading passage for his/her students, or provide a limited selection from which the students can select.

Selection of the entry "Slot Selection" **512** can provide submenu **524** that allows the user to interact with the slot generation unit **122** of reading aid unit **104**. The user submenu **524** can present categories that the user can select from, including Length **530**, Occlusion **534**, and Velocities **538**. Selection of the Length entry **530** can provide the user with a submenu **532** that allows the user to set the midline length of slot **208**, or the maximum length that the slot **208** can reach during the transition phase **412**. Selection of the Occlusion entry **534** can provide the user with an occlusion control tool **536** that permits the user to select the occlusion level of the mask **204**. In another embodiment, the Occlusion entry **534** can allow the user to set occlusion levels of occlusion portion(s) **304**. Selection of the Velocities entry **538** provides the user with a submenu **540** from which the user can choose to set the midline velocity V_{ML} or characteristics of the velocity transition profile P_{VT} or the velocity recovery profile P_{VR} (such as the timings, V_{TLE}, V_{TTE}, V_{RLE}, and V_{RTE}).

Selection of the entry "Select Class or Student" **514** can provide a teacher or school administrator with a list of students or classes that he/she can select. Once a student or class is selected, the teacher or school administrator can designate mask parameters to be used for the selected student or class and/or a reading passage (or a truncated list of reading passages) that the student can choose from before starting a reading training session.

Selection of the entry "Generate or View Reports" **516** allows the user to interact with the report generator unit **132** of reading aid unit **104**. For example, a teacher or school administrator can request a report about reading aid usage of a selected student, students in a selected class, or statistics, e.g., about students in a selected school, school district, state, etc. The report about a reading training session can include information obtained from the user interaction unit **126** of reading aid unit **104**, such as qualitative or quantitative feedback information from the reader obtained during or after the reading training session, and a record of the reader's operation of the user controls **550-554** in FIG. **5** during a training session. The record of user control operation can include which user controls **550-554** were operated in the reading training session, or where relative to the reading passage the user controls **550-554** were operated. The feedback information can be obtained by the user interaction unit **126**, e.g., by requesting feedback information from the user during or after the reading session.

During a reading training session, in which the selected reading passage is displayed in window **202**, the reader can operate the user controls **550-554** to interact with the user interaction unit **126**. The user controls **550-554** include a play/pause actuator **550**, jump actuators **552**, and velocity adjustment actuators **554**. The play/pause actuator **550** can toggle between pausing advancing of the slot **208**. The jump actuators **552** cause the slot **208** to jump a predetermined interval in the forward or backward direction (assuming left-to-right advancement), as indicated by the direction of the arrows displayed on selected jump actuator **552**. The slot **208** can be caused to jump to the beginning or ending of a component of the reading passage, such as the word, line, paragraph, page, or reading passage that the slot **208** was positioned at when the jump actuator **552** was actuated. Alternatively, the predetermined interval can be measured in time or distance (e.g., inches, centimeters, pixels, points, pica, or number of characters or words).

Actuation of the velocity adjustment actuators **554** can cause the midline velocity V_{ML} of the slot **208** to be adjusted by a predetermined amount, either by an increase or a decrease, as indicated by the symbol on the velocity adjustment actuator **554**. In an embodiment, when the midline velocity V_{ML} is adjusted, the transition and recovery velocity profiles P_{VT}, P_{VR} can be, but do not have to be adjusted, e.g., proportionately, as compared to the adjustment of the midline velocity V_{ML}. In another embodiment, actuation of velocity adjustment actuator **554** can cause a velocity included in the transition or recovery velocity profiles P_{VT}, P_{VR} to be adjusted. In this case, when one velocity is adjusted, one or more other velocities of the transition and recovery velocity profiles or the midline velocity V_{ML} can be proportionately adjusted.

The user interaction unit **126** can record each instance of a user activation of the user controls **550-554**, such as which of the user controls **550-554** were used, when in the reading training session (e.g., time relative to the start time that the session was initiated), or where in the reading passage the user controls **550-554** were used (e.g., which line and the distance from beginning of the line (e.g., inches, centimeters, pixels, points, pica, or number of characters or words)).

The user interaction unit **126** can request and store feedback information from the reader during or after the reading session. The feedback request can be in response to operation of any of the user controls **550-554**. An example feedback request can include an open-ended question, qualitative question, questions that the reader can answer with a "yes" or "no," or questions to which the reader can provide a quantitative answer by user selection or input, e.g., feedback information, such as:

- "Why did you pause the reading training session?" (e.g., in response to activation of the play/pause control **550** to effect a pause);
- "Was the reading velocity too fast?" (e.g., in response to activation of jump actuator **552** in the backwards direction);
- "Did you understand the text that you have read so far?" (e.g., in response to activation of the velocity adjustment actuator **554**); and
- "On a scale of 1-10, please rate your comprehension of the reading passage. (Note: "10" indicates the highest level of comprehension.)" (e.g., upon encountering the end of a reading passage).

The feedback information can further include results of a reading comprehension assessment that can be administered by the reading aid unit **104**, e.g., together with requesting feedback. For example, reading comprehension multiple choice questions and correct answers can be stored in the reading passage database and associated with the selected reading passage. The user interaction unit **126** can select an appropriate set of reading comprehension questions for the student (e.g., based on the student's grade level or previously assessed reading level), present the questions to the student, and assess the student's comprehension by comparing the user's answers to the correct answers. Alternatively, a reading comprehension test can be administered manually, and an assessment score (e.g., based on 100%) can be input by the teacher and stored with the student's feedback information. The feedback information received from the user in response to the feedback requests is stored and can be provided to the report generator unit **132**. Additionally, the feedback information can be used to adjust the jump interval or the amount of a velocity adjustment.

Selection of the entry "Request Testing" **518** allows the user to request that the level determination unit **130** of reading aid unit **104** administer a reading assessment for a student. The reading assessment can test the student's proficiency, such as reading rate, span of recognition at one or more reading rates, or comprehension at one or more reading rates. The assessment scores resulting from testing assessments administered by the level determination unit can be stored and/or used to set parameters of the mask **204** and slot **208**. In addition, manually entered assessment scores can be stored. These assessment results can be accessed by selection of the View Assessment Results entry **520**. For example, a teacher, principal, or school chancellor can access assessment results for a selected student, or students in a selected class, school, school district, state, etc.

FIG. **6** shows a reading passage **600** displayed in window **202** without a mask, for brevity and clarity. The passage **600** includes one or more examples of computer readable embedded codes **602***a*-**602***e* that correspond to respective portions **610***a*-**610***e* of the reading passage **600**. In some embodiments, each of the portions **610***a*-**610***e* can also be considered a reading passage. While the embedded codes can be displayed, in the current example, the embedded codes **602***a*-**602***e* are invisible to the reader. In an embodiment, the embedded codes can be stored, for example, as metadata associated with a file storing the reading passage **600**. In another embodiment, the embedded codes can be stored in a table of codes that is associated with the file storing the reading passage **600**. In another embodiment, the embedded codes can be stored in the reading passage in connection with the characters and/or portions of the reading passage.

The embedded codes **602***a*-**602***e* are recognized and decoded by the code recognition unit **128** of reading aid unit **104**. They can be recognized as the slot **208** advances through a reading passage, (e.g., portions **610***a*-**610***e*), and decoded during the reading session. Alternatively, they can be recognized and decoded before advancement through the reading passage begins.

In an embodiment, the embedded codes **602***a*-**602***e* can be embedded in the file storing the reading passage and recognized by the code recognition unit **128** as the slot **208** advances. The code recognition unit **128** can include a scout unit (not shown) that advances ahead of the slot **208**. As the slot **208** advances, the scout unit can check a position ahead of the slot **208** for embedded codes **602***a*-**602***e*.

In another embodiment, in which the embedded codes **602***a*-**602***e* are recognized and decoded before the slot **208** begins to advance, the code recognition unit **128** can use embedded code information provided with the embedded code **602***a*-**602***e*. The embedded code information can be used during slot advancement to recognize when each portion **610***a*-**610***e* associated with an embedded code **602***a*-**602***e* has been encountered.

The code recognition unit **128** determines information about the reading passage from the decoded codes **602***a*-**602***e* and provides control information to the slot advancement unit **124** and/or to the slot generation unit **122** of reading aid unit **104**. The control information controls advancement of the slot **208** and/or adjusts the mask parameters while the slot **208** advances through the corresponding portion. The codes **602***a*-**602***e* can provide information about a corresponding portion of the reading passage **600**, such as the reading difficulty level or density of information contained therein; a change in margins, format, or layout; whether the portion includes an image; or whether the portion includes information in a particular presentation, such as a graph, table, or equation.

The codes **602***a*-**602***e* can include information that specifies the beginning and ending of the corresponding passage (e.g., portions **610***a*-**610***e*). Alternatively, the codes **602***a*-**602***e* can include a first code at the beginning of the corresponding portion and an associated code at the end of the corresponding portion that the code recognition unit **128** can use to determine where the corresponding portion begins and ends. Portions can overlap one another. For example, a portion can overlap or be nested within one or more of the other portions.

Code **602***a* provides information about portion **610***a* of the reading passage **600**. The code **602***a* can indicate, for example, that portion (passage) **610***a* includes dense material, and that the midline velocity V_{ML} and/or velocities of the profiles P_{VT} and P_{VR} should be decreased. The code **602***a* can further indicate the difficulty level. The code recognition unit **128** can adjust the velocities based on the difficulty level. Alternatively, the code **602***a* can indicate an amount by which to adjust the slot's **208** velocity (e.g., 10% or 20%).

Code **602***b* provides information about portion (passage) **610***b* of the reading passage **600**. The code **602***b* can include information that indicates that portion **610***b* includes an image that the reader can view as a single unit, not line by line. The code recognition unit **128** can instruct slot advancement unit **124** to advance slot **208** by pausing the slot **208** for an interval that is appropriate for the reader to digest the information in the image, and then to skip to the end of portion **610***b*, and resume advancement at the next portion, portion **610***c*. Alternatively, code recognition unit **128** can instruct slot advancement unit **124** to advance slot **208** past portion **610***b* (e.g., above or below the image, without blocking the image). Thus, the reader can see the slot **208** as it advances. The reader can pace application of his/her attention to the image in order to be prepared to continue reading at the next portion **610***c* when the time allotted to "read" the image has passed. These techniques can be used to train a reader to gather information from an image at an effective pace, and to move his/her vision to the next portion of the reading passage **600**.

Code **602***c* provides information about portion (passage) **610***c* of the passage **600**. The code **602***c* can include information that indicates that the left margin of portion **610***c* is different than the left margin of reading passage **600** displayed in window **202**. The code recognition unit **128** can inform the slot generation unit **122** to adjust parameters of the mask **204** accordingly. For example, adjustments can be made to margins that define the beginning and ending positions of the plurality of lines in portion **602***c*. The margins can describe the layout of the plurality of lines of text in the portion **610***c* so that the slot **208** can advance properly through portion **610***c*. Additionally, adjustments can be made to the placement of the first and second markers **220**, **222** that define the transition zone **216** for portion **610***c*. It should be noted that each portion **602***a*-**602***c* can include the markers **220**, **222**.

Code **602***d* provides information about portion (passage) **610***d* of the reading passage **600**. The code **602***d* can include information that indicates that portion **610***d* has a layout that includes two columns. The code recognition unit **128** can instruct the slot generation unit **122** to adjust the margins describing the beginning and end positions of the plurality of lines in the two columns. Additionally, adjustments can be made to the first and second markers **220**, **222** to provide a transition zone **216** for each of the columns. Additionally, the code recognition unit **128** can instruct the slot advancement unit **124** to advance the slot **208** in relation to the lines of the first column, followed by the lines of the second column.

Code **602***e* provides information about portion (passage) **610***e* of the reading passage **600**. The code **602***e* can include information that indicates that portion **610***e* includes a graph that the reader should view and comprehend as a unit, not line by line, within a selectable time interval. Similar to the image in portion **610***b*, the code recognition unit **128** can instruct slot advancement unit **124** to advance slot **208** by pausing the slot **208** for an interval that is appropriate for the reader to digest the information in the graph, and then to skip to the end of portion **610***e*, and resume advancement at the next portion (not shown). Alternatively, code recognition unit **128** can instruct slot advancement unit **124** to advance slot **208** past portion **610***e* (e.g., above or below the graph, without blocking the graph). Thus, the reader can see the slot **208** as it advances. The reader can pace application of his/her attention to the graph so that the reader is prepared to continue reading at the next portion after the time allotted to "read" the graph has passed. These techniques can be used to train a reader to gather information from objects, such as graphs or tables, at an effective pace, and to move his/her vision to the next portion of the reading passage **600**.

FIGS. **7**A and **7**B show a flowchart **700** that illustrates an example method of the reading aid system **100** shown in FIG. **1**. With reference to FIGS. **2**A and **5**, at step **702**, a selected reading passage is displayed in window **202**. At step **704**, the mask parameters are initialized, e.g., in accordance with the user's reading proficiency, characteristics of the reading portion (e.g., reading level and/or density), and/or user selections. At step **706**, the slot **208** is advanced at its midline velocity V_{ML} using the mask parameters for the phase ML **410**.

At step **708**, a determination is made whether a user action or system condition is recognized that indicates that the mask parameters should be adjusted. If it is determined that a component of the reading aid system **100** recognized a system condition, then execution of method **700** continues at step **710**. At step **710**, it is determined which system recognizable condition exists. If the determined system recognizable condition that slot **208** has encountered a transition zone **216**, then execution of method **700** continues at step **712**. For example, arrival of the slot **208** at the transition zone **216** can occur when the slot's lead edge **230** encounters the first marker **220** that marks the beginning of a transition zone **216**.

At step **712**, the slot **208** is advanced through phase T **412** using the transition velocity profile P_{VT}. Phase T **412** continues until it is determined that the slot **208** has exited the transition zone **216**. The slot's **208** exit from the transition zone **216** can occur, for example, when the slot's lead edge **230** encounters the second marker **222** that demarks the end of the transition zone **216**.

At step **714**, the slot **208** is advanced through phase R **414** using the recovery velocity profile P_{VR}. Phase R **414** continues until the slot's **208** length returns to its midline length L_{ML}.

With reference to steps **712** and **714**, in one embodiment, the transition and recovery velocity profiles P_{VT}, and P_{VR} adjust the velocities of the slot's lead edge **230** and trail edge **232** at the same time and by the same amount. In this embodiment, the slot's **208** length remains the midline length L_{ML} throughout steps **712** and **714**, such that the recovery velocity profile P_{VR}, would not be used at step **714**. Other embodiments are possible as described with reference to FIGS. **2**A-**6**.

At step **716**, the slot's **208** velocity is adjusted to its midline velocity V_{ML}, after which the method **700** continues at step **706** to advance the slot **208**, in accordance with the mask parameters for the phase ML **410**.

If it is determined at step **710** that the system recognizable condition is detection of an embedded code associated with a position encountered by the slot **208**, then the method **700** continues at step **720**, where the embedded code can be decoded, e.g., if this was not yet performed. At step **722**, information about a portion of the reading passage in relation to which the slot will advance is determined based on (or from) the decoded code. The information about the portion of the reading passage can include, for example, the reading difficulty level or density of the portion; a change in margins, format, or layout within the portion; the presence of an image in the portion; or the presence of a particular presentation of reading material within the portion, such as a graph, table, or equation.

At step **724**, when the portion that corresponds to the detected embedded code is encountered, the mask parameters and/or slot position **208** are adjusted based on the information about the portion (passage) of the reading passage **600** that corresponds to the detected embedded code. At step **726**, the slot is advanced, using the adjusted slot position and/or mask parameters.

At step **728**, a determination is made whether or not the slot **208** has advanced to the end of the portion. If it is determined at step **728** that slot **108** has encountered the end of the portion associated with the embedded code, the method **700** continues at step **716** to reset the slot's **208** velocity by adjusting it back to the midline velocity V_{ML}. Encountering the end of the portion by slot **208** can be determined, for example, based on the position of slot **208**, information about the portion (e.g., obtained from the embedded code), a character(s) in the passage (e.g., a marker, symbol) or a characteristic of the passage encountered by the slot **208**, or information provided in the file that stores the reading passage. Thereafter, the method **700** continues at step **706** to advance the slot **208** in accordance with the original mask parameters for the phase ML **410**.

If it is determined at step **710** that the system recognized condition is a termination condition, then method **700** is terminated at step **730**. A termination condition can occur, for example, when the slot **208** has advanced to the end of the displayed reading passage **600** (e.g., the end of a file storing a reading passage was encountered), or a timeout condition has occurred.

If at step **708** it is determined that a user action has caused a condition to occur, the method continues at step **750**, where a determination is made as to which user action is recognized. A recognizable user action can occur, for example, when a user (e.g., a reader) operates user controls **550**-**554**.

If it is determined at step **750** that the user activated the pause/play actuator **550**, the method continues at step **752**. At step **752**, it is determined whether the user selected the pause or play function of the pause/play actuator **550**. If it is determined that the user selected the pause function, then the method continues at step **754** to wait until the user selects the play function, after which the method continues at step **706**. If it is determined at step **752** that the user selected the play function of the pause/play actuator **550**, the method continues at step **706**.

If at step **750** it is determined that the jump actuator **552** is selected, the method **700** continues at step **760**, where a request can be generated and displayed to the user for feedback related to the reason that the reader activated the jump actuator **552**. The feedback request can ask the user if the passage is too easy or difficult, whether the reading velocity set by the slot's advancement is too slow or fast, and/or whether there was an outside distraction that prompted the reader to activate the jump actuator **552**. At step **762**, the

user's response is stored as feedback information in response to the request at step **760**. The feedback information can be used when determining an interval and direction for jumping (advancing) the slot **208**. Steps **760** and **762** are optional steps as shown in dashed lines.

At step **764**, a jump interval and direction to be used for advancing the slot **208** are determined. The jump interval can be a predetermined interval, which can be retrieved from a storage location. The jump interval can further be determined based on the "sequence of activation" in which the user activated the jump actuator **552**. For example, the jump interval can be determined based on how many times the user activated the jump actuator **552** (e.g., "clicked on" in quick succession). For example, the jump interval to be used for jumping the slot **208** can be determined by multiplying the predetermined interval by the number of times the user "clicked on" the jump actuator **552** in quick succession.

In one example, when the jump actuator **552** is selected, the slot **208** is jumped (e.g., repositioned) to a position in the reading passage. The slot can be jumped to the beginning or ending of a component of the reading passage, such as the word, line, paragraph, page, or reading passage at which the slot **208** was positioned when the jump actuator **552** was actuated. For example, when the jump actuator **552** pointing to the "left" is actuated, the slot **208** can be jumped to the beginning of the word, line, paragraph, or reading passage in which the slot **208** is located at the time of the actuation. Similarly, when the jump actuator **552** pointing to the "right" is actuated, the slot **208** can be jumped to the end of the line, paragraph, or reading passage in which the slot **208** is located at the time of the actuation.

The direction to be used for advancing the slot **208** is determined based on which jump actuator **552** the user activated. In the present example, the jump actuator **552** having a symbol that points to the "right" will cause the slot **208** to be advanced in the "right" direction, and the jump actuator **552** having a symbol that points to the "left" will cause the slot **208** to be advanced in the "left" direction, in a left-to-right passage **600**. At step **766**, the slot **208** is advanced to a new position by the selected jump interval in the selected direction, after which the method continues at step **706**.

If at step **750** it is determined that the velocity adjustment actuator **554** is selected, the method **700** continues at step **780**, where a request can be generated and displayed to the user for feedback related to the reason that the reader activated the velocity adjustment actuator **554**. The feedback request can ask the user if the passage is too easy or difficult, whether the reading velocity set by the slot's advancement is too slow or fast, and/or whether there was an outside distraction that prompted the reader to activate the velocity adjustment actuator **554**. At step **782**, the user's response is stored as feedback information in response to the request at step **780**. The feedback information can be used when determining an amount and direction by which to adjust the velocity of the slot **208**. For example, the feedback information can be used to determine an adjustment to the midline velocity V_{ML}, the velocity of at least one of the slot's lead or trail edges of the slot's transition velocity profile P_{VT}, the velocity of at least one of the slot's lead or trail edges of the slot's recovery velocity profile P_{VR}, the mask parameters, and/or the slot's **208** position. Steps **780** and **782** are optional steps as shown in dashed lines.

At step **784**, the velocity adjustment amount and direction to be used for adjusting the advancement velocity of the slot **208** are determined. The amount can be a predetermined amount, which can be retrieved from a storage location. The amount can further be determined based on the "sequence of activation" in which the user activated the velocity adjustment actuator **554**. For example, the amount can be determined based on how many times the user activated the velocity adjustment actuator **554** (e.g., "clicked on" in quick succession). For example, the amount to be used for adjusting the advancement velocity of the slot **208** can be determined by multiplying the predetermined amount by the number of times the user "clicked on" the velocity adjustment actuator **554** in quick succession. The direction to be used for adjusting the velocity of the slot **208** is determined based on which velocity adjustment actuator **554** the user activated. In the present example, the velocity adjustment actuator **554** having the symbol "+" displayed thereon will cause the velocity of the slot **208** to be increased, and the actuator having the "–" symbol displayed thereon will cause the velocity of the slot **208** to be decreased.

At step **786**, the midline velocity V_{ML} of the slot **208** is adjusted in the selected direction by the selected amount. The velocity adjustment may occur immediately while the slot **208** is advanced in accordance with the midline phase and before the slot **208** advances to a next line. However, if the slot **208** has already entered the transition zone **216**, e.g., during a transition phase, then the velocity adjustment will become effective after the transition phase.

At step **788**, the transition and recovery velocity profiles P_{VT}, P_{VR} can be optionally adjusted, e.g., proportionately, to the adjustment of the midline velocity V_{ML}. The adjustment to P_{VT}, P_{VR} can occur immediately, so that it is effective the next time that the slot **208** enters the transition zone **216**. However, if the slot **208** has already entered the transition zone **216**, then the adjustment can become effective when the slot **208** advances to the next transition zone. Step **788** is an optional step. Thereafter, the method **700** continues at step **706**.

If at step **708** it is determined that a user action and a system condition were not detected, the method continues at step **706**.

FIG. **8** is a block diagram of an illustrative embodiment of a general computer system **800**. The computer system **800** can be the computing device **102** and the server **106** illustrated in FIG. **1**. The computer system **800** can include a set of instructions that can be executed to cause the computer system **800** to perform any one or more of the methods or computer based functions disclosed herein. The computer system **800**, or any portion thereof, may operate as a standalone device or may be connected, e.g., using a network or other connection, to other computer systems or peripheral devices. For example, the computer system **800** may be operatively connected to a different computing device **102**, a different server **106**, or databases **108** and **110**.

The computer system **800** may also be implemented as or incorporated into various devices, such as a personal computer (PC), a tablet PC, a personal digital assistant (PDA), a mobile device, a palmtop computer, a laptop computer, a desktop computer, a communications device, a control system, a web appliance, or any other machine capable of executing a set of instructions (sequentially or otherwise) that specify actions to be taken by that machine. Further, while a single computer system **800** is illustrated, the term "system" shall also be taken to include any collection of systems or sub-systems that individually or jointly execute a set, or multiple sets, of instructions to perform one or more computer functions.

As illustrated in FIG. **8**, the computer system **800** may include a processor **802**, e.g., a central processing unit (CPU), a graphics-processing unit (GPU), or both. Moreover, the computer system **800** may include a main memory **804** and a static memory **806** that can communicate with each other via

a bus **826**. As shown, the computer system **800** may further include a video display unit **810**, such as a liquid crystal display (LCD), an organic light emitting diode (OLED), a flat panel display, a solid state display, or a cathode ray tube (CRT). Additionally, the computer system **800** may include an input device **812**, such as a keyboard, and a cursor control device **814**, such as a mouse. The computer system **800** can also include a disk drive unit **816**, a signal generation device **822**, such as a speaker or remote control, and a network interface device **808**.

In a particular embodiment or aspect, as depicted in FIG. **8**, the disk drive unit **816** may include a computer-readable medium **818** in which one or more sets of instructions **820**, e.g., software, can be embedded. Further, the instructions **820** may embody one or more of the methods or logic as described herein. In a particular embodiment or aspect, the instructions **820** may reside completely, or at least partially, within the main memory **804**, the static memory **806**, and/or within the processor **802** during execution by the computer system **800**. The main memory **804** and the processor **802** also may include computer-readable media.

In an alternative embodiment or aspect, dedicated hardware implementations, such as application specific integrated circuits, programmable logic arrays and other hardware devices, can be constructed to implement one or more of the methods described herein. Applications that may include the apparatus and systems of various embodiments or aspects can broadly include a variety of electronic and computer systems. One or more embodiments or aspects described herein may implement functions using two or more specific interconnected hardware modules or devices with related control and data signals that can be communicated between and through the modules, or as portions of an application-specific integrated circuit. Accordingly, the present system encompasses software, firmware, and hardware implementations.

In accordance with various embodiments or aspects, the methods described herein may be implemented by software programs tangibly embodied in a processor-readable medium and may be executed by a processor. Further, in an exemplary, non-limited embodiment or aspect, implementations can include distributed processing, component/object distributed processing, and parallel processing. Alternatively, virtual computer system processing can be constructed to implement one or more of the methods or functionality as described herein.

It is also contemplated that a computer-readable medium includes instructions **820** or receives and executes instructions **820** responsive to a propagated signal, so that a device connected to a network **824** can communicate voice, video or data over the network **824**. Further, the instructions **820** may be transmitted or received over the network **824** via the network interface device **808**.

While the computer-readable medium is shown to be a single medium, the term "computer-readable medium" includes a single medium or multiple media, such as a centralized or distributed database, and/or associated caches and servers that store one or more sets of instructions. The term "computer-readable medium" shall also include any medium that is capable of storing, encoding or carrying a set of instructions for execution by a processor or that cause a computer system to perform any one or more of the methods or operations disclosed herein.

In a particular non-limiting, example embodiment or aspect, the computer-readable medium can include a solid-state memory, such as a memory card or other package, which houses one or more non-volatile read-only memories. Further, the computer-readable medium can be a random access memory or other volatile re-writable memory. Additionally, the computer-readable medium can include a magneto-optical or optical medium, such as a disk or tapes or other storage device to capture carrier wave signals, such as a signal communicated over a transmission medium. A digital file attachment to an e-mail or other self-contained information archive or set of archives may be considered a distribution medium that is equivalent to a tangible storage medium. Accordingly, any one or more of a computer-readable medium or a distribution medium and other equivalents and successor media, in which data or instructions may be stored, are included herein.

In accordance with various embodiments or aspects, the methods described herein may be implemented as one or more software programs running on a computer processor. Dedicated hardware implementations including, but not limited to, application specific integrated circuits, programmable logic arrays, and other hardware devices can likewise be constructed to implement the methods described herein. Furthermore, alternative software implementations including, but not limited to, distributed processing or component/object distributed processing, parallel processing, or virtual machine processing can also be constructed to implement the methods described herein.

It should also be noted that software that implements the disclosed methods may optionally be stored on a tangible storage medium, such as: a magnetic medium, such as a disk or tape; a magneto-optical or optical medium, such as a disk; or a solid state medium, such as a memory card or other package that houses one or more read-only (non-volatile) memories, random access memories, or other re-writable (volatile) memories. The software may also utilize a signal containing computer instructions. A digital file attachment to e-mail or other self-contained information archive or set of archives is considered a distribution medium equivalent to a tangible storage medium. Accordingly, a tangible storage medium or distribution medium as listed herein, and other equivalents and successor media, in which the software implementations herein may be stored, are included herein.

Thus, system and method to reconstruct cardiac activation information have been described. Although specific example embodiments or aspects have been described, it will be evident that various modifications and changes may be made to these embodiments or aspects without departing from the broader scope of the invention. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense. The accompanying drawings that form a part hereof, show by way of illustration, and not of limitation, specific embodiments or aspects in which the subject matter may be practiced. The embodiments or aspects illustrated are described in sufficient detail to enable those skilled in the art to practice the teachings disclosed herein. Other embodiments or aspects may be utilized and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. This Detailed Description, therefore, is not to be taken in a limiting sense, and the scope of various embodiments or aspects is defined only by the appended claims, along with the full range of equivalents to which such claims are entitled.

Such embodiments or aspects of the inventive subject matter may be referred to herein, individually and/or collectively, by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept if more than one is in fact disclosed. Thus, although specific embodiments or aspects have been illustrated and described herein, it should be appreciated that any arrangement calculated to achieve the same purpose may be substituted for the specific embodi-

ments or aspects shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments or aspects. Combinations of the above embodiments or aspects, and other embodiments or aspects not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

The Abstract is provided to comply with 37 C.F.R. §1.72(b) and will allow the reader to quickly ascertain the nature and gist of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims.

In the foregoing description of the embodiments or aspects, various features are grouped together in a single embodiment for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting that the claimed embodiments or aspects have more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment or aspect. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate example embodiment or aspect. It is contemplated that various embodiments or aspects described herein can be combined or grouped in different combinations that are not expressly noted in the Detailed Description. Moreover, it is further contemplated that claims covering such different combinations can similarly stand on their own as separate example embodiments or aspects, which can be incorporated into the Detailed Description.

The invention claimed is:

1. A computerized method of controlling a reading slot to provide aid to a user in reading a passage, wherein the method comprises:

generating, by a processing device, a mask having an opaque portion and the slot, the opaque portion covering a plurality of lines having characters that are visible through the slot, the plurality of lines including at least a first line and a second line, the slot including a lead edge and an opposing trail edge that define a length dimension having a first length between the lead edge and the trail edge of the slot;

advancing, by the processing device, the slot at a midline velocity in relation to the first line of the passage; and

increasing, by the processing device, the velocity of at least one of the lead edge and the trail edge of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage from the first line to the second line, wherein increasing the velocity increases the length dimension between the lead edge and the trail edge from the first length to a second length.

2. The method according to claim **1**, wherein the method further comprises displaying the mask over the plurality of lines.

3. The method according to claim **1**, wherein the method further comprises accessing reading proficiency of the user.

4. The method according to claim **3**, wherein the method further comprises determining an opacity level of the mask based on the reading proficiency of the user.

5. The method according to claim **3**, wherein the method further comprises determining and selecting the midline velocity based on the reading proficiency of the user.

6. The method according to claim **3**, wherein the method further comprises determining the length dimension of the slot based on the reading proficiency of the user.

7. The method according to claim **3**, wherein the slot includes a translucent portion and a semi-opaque portion, wherein the method further comprises setting at least one of a length dimension of the semi-opaque portion and a degree of opaqueness of the semi-opaque portion based on the reading proficiency of the user.

8. The method according to claim **1**, wherein the method further comprises determining when the slot enters the transition zone based on a marker associated with the first line of the passage.

9. The method according to claim **1**, wherein the method further comprises decreasing the velocity of at least one of the slot's lead and trail edges such that the length dimension decreases between the slot's lead and trail edges in accordance with the transition velocity profile until the length dimension reaches a predetermined dimension.

10. The method according to claim **1**, wherein the method further comprises adjusting the velocity of the slot's lead and trail edges at different times.

11. The method according to claim **1**, wherein the method further comprises decreasing the velocity of at least one of the slot's lead and trail edges in accordance with a digital recovery velocity profile when the slot exits the transition zone.

12. The method according to claim **1**, wherein the method further comprises determining when the slot exits the transition zone based on a marker associated with the second line of the passage.

13. The method according to claim **1**, wherein the method further comprises adjusting at least one of the slot's position or advancement based on a code related to the passage, wherein the code is embedded in the passage or is associated with the passage.

14. The method according to claim **1**, wherein the method further comprises:

receiving a request to adjust one of: a position of the slot, the velocity of the slot, and a velocity of at least one of a lead edge or trail edge of the slot; and

adjusting at least one of: the slot position, the velocity of the slot, and the velocity of the at least one of the lead edge and trail edge of the slot.

15. The method according to claim **14**, wherein the method further comprises:

receiving feedback information from the user in response to the request to adjust; and

adjusting, based on the feedback information, at least one of: a selected distance for position of the slot, an amount for velocity of the slot, an amount for the velocity of the lead edge and trail edge of the slot.

16. A system to control a reading slot to provide aid to a user in reading a passage, the system comprising:

a processor; and

a memory storing instructions that, when executed by the processor, cause the processor to perform operations comprising:

generating a mask having an opaque portion and the slot, the opaque portion to cover a plurality of lines having characters that are visible through the slot, the plurality of lines including at least a first line and a second line, the slot including a lead edge and an opposing trail edge that define a length dimension having a first length between the lead edge and the trail edge of the slot;

advancing the slot at a midline velocity in relation to the first line of the passage; and

increasing the velocity of at least one of the lead edge and the trail edge of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage, wherein increasing the velocity increases the length dimension between the lead edge and the trail edge from the first length to a second length.

17. The system according to claim 16, wherein the operations further comprise displaying the mask over the plurality of lines.

18. The system according to claim 16, wherein the operations further comprise accessing reading proficiency of the user.

19. The system according to claim 18, wherein the operations further comprise determining an opacity level of the mask based on the reading proficiency of the user.

20. The system according to claim 18, wherein the operations further comprise determining the midline velocity based on the reading proficiency of the user.

21. The system according to claim 18, wherein the operations further comprise determining the length dimension of the slot based on the reading proficiency of the user.

22. The system according to claim 18, wherein the slot includes a translucent portion and a semi-opaque portion, wherein the operations further comprise setting at least one of a length dimension of the semi-opaque portion and a degree of opaqueness of the semi-opaque portion based on the reading proficiency of the user.

23. The system according to claim 16, wherein the operations further comprise determining when the slot enters the transition zone based on a marker associated with the first line of the passage.

24. The system according to claim 16, wherein the operations further comprise decreasing the velocity of at least one of the slot's lead and trail edges such that a length dimension decreases between the slot's lead and trail edges in accordance with the transition velocity profile until the length dimension reaches a predetermined dimension.

25. The system according to claim 16, wherein the operations further comprise adjusting the velocity of the slot's lead and trail edges at different times.

26. The system according to claim 16, wherein the operations further comprise decreasing the velocity of at least one of the slot's lead and trail edges in accordance with a digital recovery velocity profile when the slot exits the transition zone.

27. The system according to claim 16, wherein the operations further comprise determining when the slot exits the transition zone based on a marker associated with the second line of the passage.

28. The system according to claim 16, wherein the operations further comprise adjusting at least one of the slot's position or advancement based on a code related to the passage, wherein the code is embedded in the passage or is associated with the passage.

29. The system according to claim 16, wherein the operations further comprise:

receiving a request to adjust one of: a position of the slot, the velocity of the slot, and a velocity of at least one of a lead edge or trail edge of the slot; and

adjusting at least one of: the slot position, the velocity of the slot, and the velocity of the at least one of the lead edge and trail edge of the slot.

30. The system according to claim 29, wherein the operations further comprise:

receiving feedback information from the user in response to the request to adjust; and

adjusting, based on the feedback information, at least one of: a selected distance for the position of the slot, an amount for velocity of the slot, and an amount for the velocity of the at least one of the lead edge and trail edge of the slot.

31. A method of controlling a reading slot to provide aid to a user in reading a passage, wherein the method comprises:

determining, by a processing device, a length dimension associated with the slot based at least on a reading proficiency of the user;

generating, by the processing device, a mask having an opaque portion and the slot, the opaque portion covering a plurality of lines having characters that are visible through the slot, the plurality of lines including at least a first line and a second line, the slot including a lead edge and an opposing trail edge defined according to the length dimension between the lead edge and the trail edge of the slot;

advancing, by the processing device, the slot at a midline velocity in relation to the first line of the passage; and

increasing, by the processing device, the velocity of the slot in accordance with a digital transition velocity profile when the slot enters a transition zone of the passage from the first line to the second line.

32. The method according to claim 31, wherein increasing the velocity of the slot comprises increasing the length dimension between the lead edge and the trail edge.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,189,969 B1
APPLICATION NO. : 14/307037
DATED : November 17, 2015
INVENTOR(S) : Taylor et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page, Item (72) Inventor, should read

-- (72) Inventors:

Stanford E. Taylor, Burlington, VT (US); **S. Mark Taylor**, Charlotte, VT (US); **Alexandra N. Spichtig**, Essex Junction, VT (US); **Ralph Radach**, Carrabelle, FL (US) --.

Signed and Sealed this
Eighth Day of November, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office